

SP-W2 Contaminant Accumulation in SedimentsFish, Sediments, and the Aquatic Food Chain

~~December 11, 2001~~March 1927, 2002

1.0 Introduction/Background

The Environmental Work Group has identified ~~contamination~~contaminant accumulation in-of fish, sediment ~~accumulation~~and the aquatic food chain ~~behind Oroville Dam~~ as a potentially significant issue. ~~Sediments trapped behind the dam are potentially laden with metals and organic contaminants, which may bioaccumulate in the food web. Sediments carried into Lake Oroville initially deposit into the upper tributary arms. Decreasing reservoir levels, periodic discharge surges from upstream hydropower generation, and increased tributary discharges from fall rains rework these deposits and carry them further into the reservoir.~~

an issue of concern. Contamination of fish from mercury and other metals and organic contaminants is a significant concern in many areas of California, including the Feather River watershed. Lake Oroville tributaries in the upper Feather River watershed experienced significant gold mining activity during the Gold Rush era, and continue to experience significant recreational gold mining activity. Numerous large mercury mines were developed in the Coast Range to supply mercury as an amalgam for gold extraction in the Feather River and other areas. Mercury lost to the tributaries during gold mining operations is slowly being transported downstream with sediments. Though the Gold Rush era has long since passed, significant quantities of mercury still remain in the streams tributary to and in Lake Oroville.

Potentially occurring anoxic conditions beneath the sediment-water interface at the reservoir bottom create ideal conditions for biologically mediated liberation of methyl mercury by sulfate-reducing bacteria. The redistribution of methyl mercury in the water column during lake mixing in the fall and winter may facilitate bioaccumulation into the food web, including plankton, fish, and piscivorous birds and other animals, including humans.

In addition, other industrial activities in the upper Feather River watershed have contributed metal and organic contaminants, including polychlorinated biphenyls (PCBs), which also have an affinity for sediments and bioaccumulate in the food web. Re-suspended sediments and recycled metals and organic contaminants in Lake Oroville can be transported downstream to other project waters, including the Diversion Pool, Thermalito Afterbay and Forebay, Oroville Wildlife Area ponds, and the Feather River, where uptake and bioaccumulation in aquatic organisms can occur.

Sediments trapped behind the dam are potentially laden with metals and organic contaminants, which may bioaccumulate in the food web. Sediments carried into Lake Oroville initially deposit into the upper tributary arms. Sediment deposits are transported further into the reservoir due to: 1) natural high flow hydrologic events; 2) reduced reservoir levels, and 3) periodic discharge surges from upstream hydropower generation. Decreasing reservoir levels, periodic discharge surges from upstream hydropower generation, and increased tributary discharges from fall rains rework these deposits and carry them further into the reservoir.

2.0 Study Objective

The objectives of the study are to determine evaluate: 1) the level evaluate potential 1) the magnitude and extent of bioaccumulation of metals and organic contaminants in aquatic organisms within the project-affected area, and 2) the sources and of metals and organic contaminants in sediments impounded within project waters; 2) and potential effects of pathways of contamination that contribute to bioaccumulation including from contaminated sediments on the food web in the project area, and 3) effects deposited as a result of project features, operations, and maintenance, on sediment contamination and bioaccumulation in aquatic organisms.

3.0 Relationship to Relicensing/Need for the Study

Sediments in Feather River tributaries are known to carry metal and organic contaminants. Prior to construction of Oroville Dam, sediments carried by the tributaries and the main stem of the Feather River in the reservoir footprint were transported downstream. Subsequent to completion of the dam, sediments carried by the tributaries settle into the upper arms of Lake Oroville, but are reworked by stream flows as reservoir levels drop throughout the summer and are redeposited further into the reservoir area. Thermal stratification in the reservoir during the summer can facilitate the leaching of metals and organic contaminants from the sediments into the water column, where they become available for uptake by aquatic life or release downstream. In addition, sediment dwelling organisms (e.g., crayfish, insects) ingest the sediments and can absorb contaminants. Contaminants in lower trophic levels are bioaccumulated in higher trophic level organisms, and may reach levels that are deleterious to other organisms (including listed species and humans) that ingest them.

Impoundment of the reservoir created conditions in which sediments laden with contaminants are trapped and can bioaccumulate in the food web. Water with bioavailable forms of metals and organic contaminants that is released from the reservoir may contribute to bioaccumulation in downstream organisms. Bioaccumulation may not have been significant downstream from the dam prior to its construction because the metals and organic contaminants were bound to the sediment particles, not readily available for uptake, and transported out of the system with higher flows.

The California Department of Water Resources (DWR) and State Water Resources Control Board have conducted limited sampling for metals in some fish from the reservoir and Feather River downstream from the dam. Analyses of the few fish from Lake Oroville and the Feather River have detected mercury at concentrations that exceed current U.S. Environmental Protection Agency (EPA) and California Office of Environmental Health Hazard Assessment criteria. These data are not sufficient to determine the magnitude and extent of mercury contamination in fish and other organisms, nor the source. Additional analyses of fish tissue for mercury and other metals and organic contaminants is necessary to determine project effects and compliance with Basin Plan objectives.

No data are available concerning contaminants in sediments in project water bodies. Sampling of sediments is necessary to determine whether contamination of biota (if found) is attributable to contaminant sources

located within the reservoir or upstream from the project and to provide information that could be used to develop potential protection, mitigation and enhancement measures..

3.0 Relationship to Relicensing/Need for the Study

Sediments in Feather River tributaries are known to carry metal and organic contaminants. Prior to construction of Oroville Dam, sediments carried by the tributaries and the main stem of the Feather River in the reservoir footprint were transported downstream. Subsequent to completion of the dam, sediments carried by the tributaries settle into the upper arms of Lake Oroville, but are reworked by stream flows as reservoir levels drop throughout the summer and are redeposited further into the reservoir area. Thermal stratification in the reservoir during the summer can facilitate the leaching of metals and organic contaminants from the sediments into the water column, where they become available for uptake by aquatic life or release downstream. In addition, sediment dwelling organisms (e.g., crayfish, insects) ingest the sediments and can absorb contaminants. Contaminants in lower trophic levels are bioaccumulated in higher trophic level organisms, and may reach levels that are deleterious to other organisms (including listed species and humans) that ingest them.

Impoundment of the reservoir created conditions in which sediments possibly laden with contaminants are trapped, which could then allow bioaccumulation of contaminants in the food web. Water with bioavailable forms of metals and organic contaminants that is released from the reservoir may contribute to bioaccumulation in downstream organisms. Bioaccumulation may not have been significant downstream from the dam prior to its construction because the metals and organic contaminants were bound to the sediment particles, not readily available for uptake, and transported out of the system with higher flows.

The California Department of Water Resources and State Water Resources Control Board have conducted limited sampling for metals in some fish from the reservoir and Feather River downstream from the dam. Analyses of the few fish from Lake Oroville and the Feather River have detected mercury at concentrations that exceed current U.S. Environmental Protection Agency and California Office of Environmental Health Hazard Assessment criteria. These data are not sufficient to determine the magnitude and extent of mercury contamination in fish and other organisms, nor the source. Additional analyses of fish tissue for mercury and other metals and organic contaminants is necessary to determine project effects and compliance with Basin Plan objectives.

area. A variety of wildlife species prey on fish or other aquatic species from project waters. These wildlife species could suffer adverse physiological or reproductive responses from ingestion of prey species containing elevated levels of certain contaminants. Contaminants ingested by wildlife species that prey on aquatic species from project waters can also be bioaccumulated and passed on to other predatory fish and wildlife species that in turn prey on them.

Since recreation, including fishing, is a major beneficial use at project facilities, analysis of ~~sediments~~fish tissues would provide valuable information for fish consumption advisories. ~~For instance, one of the reservoir arms may be less contaminated than the others and not warrant the same restrictions as other reservoir locations for consumption of fish. This could only be determined by analyzing sediment samples, since~~

identification of fish with high contaminant loads in a particular area may be due to their recent migration into the sampling area from other contaminated sites. Knowing the location and extent of sediment contamination can help determine and develop reservoir management practices (licensing conditions) that improve the overall water quality and natural and recreational resources of the reservoir.

PRELIMINARY DRAFT

In addition, some contaminants are not strong bioaccumulators (e.g., some metals such as copper and arsenic), but may be mobilized and made available to the biota under certain environmental conditions (resuspension of sediment deposits from the arms to the main body, depressed oxygen and pH conditions, etc.) found in the reservoir. Organisms can become re-exposed to contaminants as the lake level drops and deposited sediments are resuspended and transported further into the reservoir. The shallow, relatively warm, organic-rich waters of the Forebay and Afterbay are ideal for the methylation of mercury and dissolution of other metals and organic contaminants. Environmental conditions such as these in project water bodies may promote mobilization of sediment bound contaminants and transport out of the "project area" where they could affect threatened and endangered species.

Sediment contamination information can be used to determine where to focus efforts to reduce sediment loading to improve water quality in the reservoir.

Demonstration of compliance with basin plan objectives is necessary for the SWRCB to issue a water quality certification. Basin plan objectives include provisions against increases in suspended sediment discharges and deposition of material that adversely affect beneficial uses, and toxic substances that produce detrimental effects to humans, plants, animals, and aquatic life. The water quality certification is needed to file with the application for license renewal with the Federal Energy Regulatory Commission. Information derived from this study will be used to demonstrate compliance with water quality standards and other appropriate requirements in the application for water quality certification. Information from the study is also needed to address concerns related to endangered species that feed on potentially contaminated aquatic organisms in the project area.

4.0—Study Area

The Study Area is generally within the FERC project boundary, but also includes lands adjacent to the project boundary where piscivorous species may occur. The vulnerability of piscivorous species to bioaccumulated contaminants will be evaluated in the terrestrial studies if fish eaten as prey are found to contain high levels of contaminants. The assessment of piscivorous susceptibility will be evaluated through a literature review of effects from the specific contaminants identified in this study as occurring in significant concentrations in prey species.

Specific water bodies included in this study plan are the North, Middle, and South forks of the Feather River and the West Branch and Concow Creek just above their confluences with the reservoir, Lake Oroville, Diversion Pool, Thermalito Forebay and Afterbay, Feather River from Oroville Dam to just downstream from the Afterbay Outlet, and Oroville Wildlife Area ponds.

5.0—General Approach

Detailed Methodology and Analysis

This study will be conducted in phases. The first phase will emphasize analysis of metals and organic contaminants in fish and crayfish in the project area. If the first phase detects metals or organic contaminants at levels greater than criteria for protection of human health or fish and crayfish predators, the second phase will be initiated. The second phase, if necessary, will evaluate metals and organic contaminants in sediments, fish, and crayfish in tributaries to the reservoir to provide background data needed to evaluate the role of the reservoir in bioaccumulation. Sampling of sediments may be necessary to determine whether contamination of biota (if found) is attributable to contaminant sources located within the reservoir or upstream from the project area and if contamination is local or widespread. Certain areas may be less contaminated than others and not warrant the same restrictions as other reservoir locations for consumption of fish. This could only be determined by analyzing sediment samples, since identification of fish with high contaminant loads in a particular area may be due to their recent migration into the sampling area from other contaminated sites. Knowing the location and extent of sediment contamination can help determine and develop reservoir management practices (licensing conditions) that improve the overall water quality and natural and recreational resources of the reservoir.

In addition, some contaminants are not strong bioaccumulators (e.g., some metals such as copper and arsenic), but may be mobilized and made available to the biota under certain environmental conditions (resuspension of sediment deposits from the arms to the main body, depressed oxygen and pH conditions, etc.) found in the reservoir. Organisms can become re-exposed to contaminants as the lake level drops and deposited sediments are resuspended and transported further into the reservoir. The shallow, relatively warm, organic rich waters of the Forebay and Afterbay could contribute to the methylation of mercury and dissolution of other metals and organic contaminants. Environmental conditions such as these in project water bodies may promote mobilization of sediment bound contaminants and transport out of the "project area" where they could affect threatened and endangered species.

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Demonstration of compliance with basin plan objectives is necessary for the SWRCB to issue a water quality certification. Basin plan objectives include provisions against increases in suspended sediment discharges and deposition of material that adversely affect beneficial uses, and toxic substances that produce detrimental effects to humans, plants, animals, and aquatic life. The water quality certification is needed for license renewal with the Federal Energy Regulatory Commission. Information derived from this study will be used to demonstrate compliance with water quality standards and other appropriate requirements in the application for water quality certification.

Information from the study is also needed to address USFS, USFWS, and NMFS concerns related to fish and wildlife species that feed on potentially contaminated aquatic organisms in the project area.

4.0 Study Area

The study area is generally within the FERC project boundary, but also includes lands adjacent to the project boundary where piscivorous species may occur.

The first phase of this study will focus on evaluation of contaminants in project waters. ~~Subsequent phases~~Phase Two, if necessary, will evaluate contamination in reservoir tributaries and the Feather River downstream from the project area.

Study plans approved by the Environmental Work Group define the limits of the study area. If initial study results indicate that the study area should be expanded or contracted, the Environmental Work Group will discuss the basis for change and revise the study area as appropriate.

5.0 General Approach

Detailed Methodology and Analysis

This study will be conducted in phases. The first phase will emphasize analysis of metals and organic contaminants in fish and crayfish in the project area. ~~The first phase will collect fish tissues and sediment samples from 15 locations in the Project area. Sediment samples will be appropriately stored for later analysis. Analyses from fish tissue samples and water quality results from SP-W1 will be presented by early summer, 2002. In Phase Two, the Environmental Work Group will use Phase One data to select six of the collected sediment samples to be analyzed for methylmercury, total mercury and PCBs. Additional constituents may be analyzed from these six and any or all of the other nine samples based upon results from fish tissue and water quality sampling. Other sediment may be collected to augment the 15 samples. If the first phase detects metals or organic contaminants at levels greater than criteria for protection of human health or fish and crayfish predators or Study Plan SP-W1 indicates water quality conditions associated with enhanced bioaccumulation, the second phase will be initiated to further evaluate those contaminants identified in the first phase. The second phase, if necessary, may~~The second phase would also evaluate metals and organic contaminants in sediments in the project area and theand additional fish and crayfish, depending on the results of the first phase. The environmental compartments analyzed in subsequent phases will be determined in consultation extent of project related impacts to fish, crayfish, and sediments downstream from the project area.

Task 1—Project Area Metals and Organic Contaminant Assessment

Water bodies sampled for Task 1 of the study will include Oroville Reservoir, Diversion Pool, Thermalito Forebay and Afterbay, low flow section of the Feather River, Feather River immediately downstream from the Afterbay Outlet, and Oroville Wildlife Area ponds.

Task 1A—Sample Collection

~~Specific fish species sampled is dependent on the types resident in the water body sampled. Newly planted fish (i.e., less than one year residency) will be avoided. Two size classes of at least two species will be targeted from each sampling site. Following the protocol of the California Office of Environmental Health Hazard Assessment, composites of at least five fish for~~

each size class will be collected. Each size class will be composed of fish with no greater than 20-percent weight difference between the largest and smallest fish. Fish will be collected beginning in the late spring with gill nets, hook and line, or seining. Fish will be weighed and measured, wrapped in aluminum foil, and immediately frozen for transport to the laboratory.

? Crayfish, if present, will be collected from the same sites from which fish are collected. Larger (older) crayfish will be targeted. At least ten crayfish of similar size from each site will be composited. Crayfish will be collected by hand, nets, or baited traps. Crayfish will be wrapped in aluminum foil and frozen for transport to the laboratory.

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- ~~Lake Oroville~~ — A comprehensive survey of fish and crayfish contamination in Lake Oroville requires multiple sampling sites in each arm and the main body of the reservoir. Fish and crayfish, if present, will be collected from sampling sites in the upper and mid reaches in each of the North, Middle, and South fork arms and from both the east and west sides of the main body of the reservoir.

Targeted fish species will include largemouth or smallmouth bass and channel catfish from the reservoir arms, and largemouth bass, channel catfish, and chinook or coho salmon from the main body of the reservoir.

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- ~~Diversion Pool~~ — The Diversion Pool will be sampled near the Diversion Dam. Fish targeted for collection from the Diversion Pool will include largemouth or smallmouth bass, and chinook or coho salmon. Crayfish will be collected from the same site.
- ~~Thermalito Forebay, Thermalito Afterbay, and Oroville Wildlife Area~~ — One monitoring site will be established in the south Thermalito Forebay. The Thermalito Afterbay will be sampled in both the northern and southern regions. Specific sampling sites in the Thermalito Afterbay will be determined in consultation with State and federal agency staff due to the complex water currents and potential for methylation of mercury in this water body. Two representative ponds will be sampled in the Oroville Wildlife Area both upstream and downstream from the Afterbay Outlet. If analyses of samples indicate significant variation in contaminant levels in these water bodies, additional samples may be necessary. Warmwater fish species targeted in these water bodies will include largemouth or smallmouth bass and channel catfish. Crayfish will be collected from the same areas as the fish.

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- ~~Lower Feather River~~ — The Feather River downstream from Oroville Dam will be sampled at one site in the low flow section between the fish hatchery and Afterbay Outlet and at another site downstream from the outlet within the project boundary. Targeted fish species will include smallmouth bass, channel catfish, and pikeminnow. Crayfish will be collected from riffle or pool areas.

Task 1B—Sample Analysis

Analytical procedures will follow those used in the Toxic Substances Monitoring Program conducted by the State Water Resources Control Board and Department of Fish and Game. Metals, pesticides, polychlorinated biphenyls, and polynuclear aromatic hydrocarbons are analyzed for this program (Table 1). PCB congeners analyzed will be those determined to pose significant ecological risks in a U.S. Environmental Protection Agency-sponsored study (USEPA 1998).

Table 1. Metals and Organic Contaminants for Analyses

| Analyte | Reporting Limit ppb (ng/g) | Analyte | Reporting Limit ppb (ng/g) |
|--|-------------------------------|------------------------|-------------------------------|
| Organochlorine Pesticides by EPA Method 8081A | | | |
| aldrin | 1 | dieldrin | 1 |
| alpha-BHC | 1 | endosulfan I | 2 |
| beta-BHC | 2 | endosulfan II | 2 |
| gamma-BHC | 1 | endosulfan sulfate | 2 |
| delta-BHC | 1 | endrin | 2 |
| alpha-chlordane | 1 | endrin aldehyde | 2 |
| gamma-chlordane | 1 | endrin ketone | 2 |
| alpha-chlordene | 1 | heptachlor | 1 |
| gamma-chlordene | 1 | heptachlor epoxide | 1 |
| chlorpyrifos | 2 | Kelthane (dicofol) | 2 |
| chlorthal (daethal) | 2 | methoxychlor | 10 |
| 2,4'-DDD | 2 | mirex | 2 |
| 2,4'-DDE | 2 | nonachlor, cis | 2 |
| 2,4'-DDT | 2 | nonachlor, trans | 2 |
| 4,4'-DCBP | 2 | oxadiazon | 2 |
| 4,4'-DDD | 2 | oxychlordane | 2 |
| 4,4'-DDE | 2 | tetradifon (tedion) | 2 |
| 4,4'-DDT | 2 | toxaphene | 100 |
| 4,4'-DDMU | 2 | | |
| Polynuclear Aromatic Hydrocarbons by EPA Method 8270C/SIM | | | |
| acenaphthene | 10 | fluoranthene | 10 |
| acenaphthylene | 10 | fluorene | 10 |
| anthracene | 10 | indeno(1,2,3-cd)pyrene | 10 |
| benzo(a)anthracene | 10 | 3-methylcholanthrene | 10 |
| benzo(b,j&k)fluoranthene | 10 | 1-methylnaphthalene | 10 |
| benzo(g,h,i)perylene | 10 | 2-methylnaphthalene | 10 |
| benzo(a)pyrene | 10 | 1-methylphenanthrene | 70 |
| benzo(e)pyrene | 10 | naphthalene | 10 |
| biphenyl | 10 | perylene | 10 |
| chrysene | 10 | phenanthrene | 10 |
| dibenzo(a,h)anthracene | 10 | pyrene | 10 |

| Analyte | Reporting Limit ppb (ng/g) | Analyte | Reporting Limit ppb (ng/g) |
|---|--------------------------------------|----------------------------|-------------------------------|
| 2,6 dimethylnaphthalene | 10 | 2,3,5 trimethylnaphthalene | 10 |
| Polychlorinated Biphenyls (PCB) Congeners by GC/ECD w/congener standards | | | |
| Congener | Reporting Limit ppb (ng/g) | Congener | Reporting Limit ppb (ng/g) |
| 8 | 0.6 | 128 | 0.6 |
| 15 | 0.6 | 132 | 0.6 |
| 18 | 0.6 | 137 | 0.6 |
| 27 | 0.6 | 138 | 0.6 |
| 28 | 0.6 | 149 | 0.6 |
| 29 | 0.6 | 151 | 0.6 |
| 31 | 0.6 | 152 | 0.6 |
| 44 | 0.6 | 156 | 0.6 |
| 49 | 0.6 | 157 | 0.6 |
| 52 | 0.6 | 158 | 0.6 |
| 66 | 0.6 | 167 | 0.6 |
| 70 | 0.6 | 169 | 0.6 |
| 74 | 0.6 | 170 | 0.6 |
| 77 | 0.6 | 171 | 0.6 |
| 81 | 0.6 | 177 | 0.6 |
| 87 | 0.6 | 180 | 0.6 |
| 95 | 0.6 | 183 | 0.6 |
| 97 | 0.6 | 187 | 0.6 |
| 99 | 0.6 | 189 | 0.6 |
| 101 | 0.6 | 194 | 0.6 |
| 105 | 0.6 | 195 | 0.6 |
| 110 | 0.6 | 200 | 0.6 |
| 114 | 0.6 | 201 | 0.6 |
| 118 | 0.6 | 203 | 0.6 |
| 123 | 0.6 | 206 | 0.6 |
| 126 | 0.6 | 209 | 0.6 |
| Organophosphorus Pesticides by EPA Method 8141A | | | |
| chlorpyrifos | 2 | parathion, ethyl | 2 |
| diazinon | 20 | parathion, methyl | 4 |
| Metals by EPA Method 6020 (ICPMS) | | | |
| arsenic* | 0.02 | mercury | 0.01 |
| cadmium | 0.005 | nickel | 0.01 |
| chromium | 0.1 | selenium* | 0.02 |
| copper | 0.006 | silver | 0.005 |
| lead | 0.007 | zinc | 0.06 |
| Miscellaneous Sediment Analyses | | | |
| Percent organic carbon | EPA Method 9060 | | |
| Acid-volatile sulfides | EPA ABS/SEM procedures, Dec. 2, 1991 | | |
| Nonyl phenols | GC-MS/DFG | | |

**analysis with methanol addition*

Methylmercury is assumed to be the form of mercury available for bioaccumulation in the food web. Most mercury in fish tissues is in the methylmercury fraction. Total mercury, however, is typically analyzed and is assumed to represent the methylmercury content of tissues. Fish muscle (filet) tissue is analyzed for the metals arsenic, cadmium, nickel, mercury, and selenium, while fish liver is analyzed for copper, zinc, chromium, lead, and zinc. All organic chemicals in fish are analyzed from filets. Whole body analyses of metals and organic chemicals are performed from very small fish and crayfish. Crayfish are shelled at the laboratory prior to analysis. All fish and crayfish analyses will be performed at the Department of Fish and Game Water Pollution Control Laboratory in Rancho Cordova or the West Coast Analytical Services laboratory in Santa Fe Springs, California.

Tissue concentrations of metals and organic chemicals are measured on a wet weight basis. In addition to wet weight measures, organic chemicals are also expressed on a lipid weight basis since chlorinated hydrocarbons partition into lipid rich tissues of aquatic organisms. Season, water temperature, health of the organism, stress on the organism, and type of species can affect the lipid levels of samples, and cause variability in results. Therefore, lipid weight values may represent a more realistic measure of environmental availability of chlorinated hydrocarbons than wet weight values. Wet weight measures, however, are preferred because all standards for human health and predator protection are based on wet weight measures. Also, wet weight measures better reflect the exposure of predators or humans to the actual concentration in freshly caught fish.

Task 2—Metals and Organic Contaminant Assessment Pathways

If analyses in Task 1 demonstrate significant contamination of fish or crayfish (i.e., criteria exceeded), a second phase will evaluate sediment, fish, and crayfish contamination in the tributaries to the reservoir to determine background (i.e., upstream) contributions to bioaccumulation and organic contamination. In addition, sediment, fish, and crayfish would be sampled downstream from the project area in the Feather River to evaluate the extent of possible project effects on downstream contamination. Parameters analyzed would include both metals and organic contaminants that were found to be significant in Task 1. Sediments and possibly additional fish (such as threadfin shad or wakasagi) will also be sampled for metals and organic contaminants in the project area water bodies sampled in Task 1 where contamination was found to be significant.

Task 2A—Sample Collection

with appropriate resource and health agencies and the Environmental Work Group or Task Force. Analyses in subsequent phases in tributaries to the reservoir would provide background data needed to evaluate the role of the reservoir in bioaccumulation. Subsequent analyses in sediments and additional fish in the project area would provide information to determine the extent and sources of contamination, and species affected. The extent of project related impacts to fish, crayfish, and sediments downstream from the project area would also be analyzed in subsequent phases. If initial study results indicate that the methods and tasks should be

modified, the Environmental Work Group will discuss the basis for change and revise the study plan as appropriate.

Phase 1—Project Area Metals and Organic Contaminant Assessment

Water bodies sampled for Phase 1 of the study will include Oroville Reservoir, Diversion Pool, Thermalito Forebay and Afterbay, low flow section of the Feather River, Feather River immediately downstream from the Afterbay Outlet, and an Oroville Wildlife Area pond (Figure SP-W2-1). Tasks that will be undertaken in Phase 1 include sample collection, laboratory analyses, and data interpretation.

Figure SP-W2-1. Phase 1 Contaminant Monitoring Sites

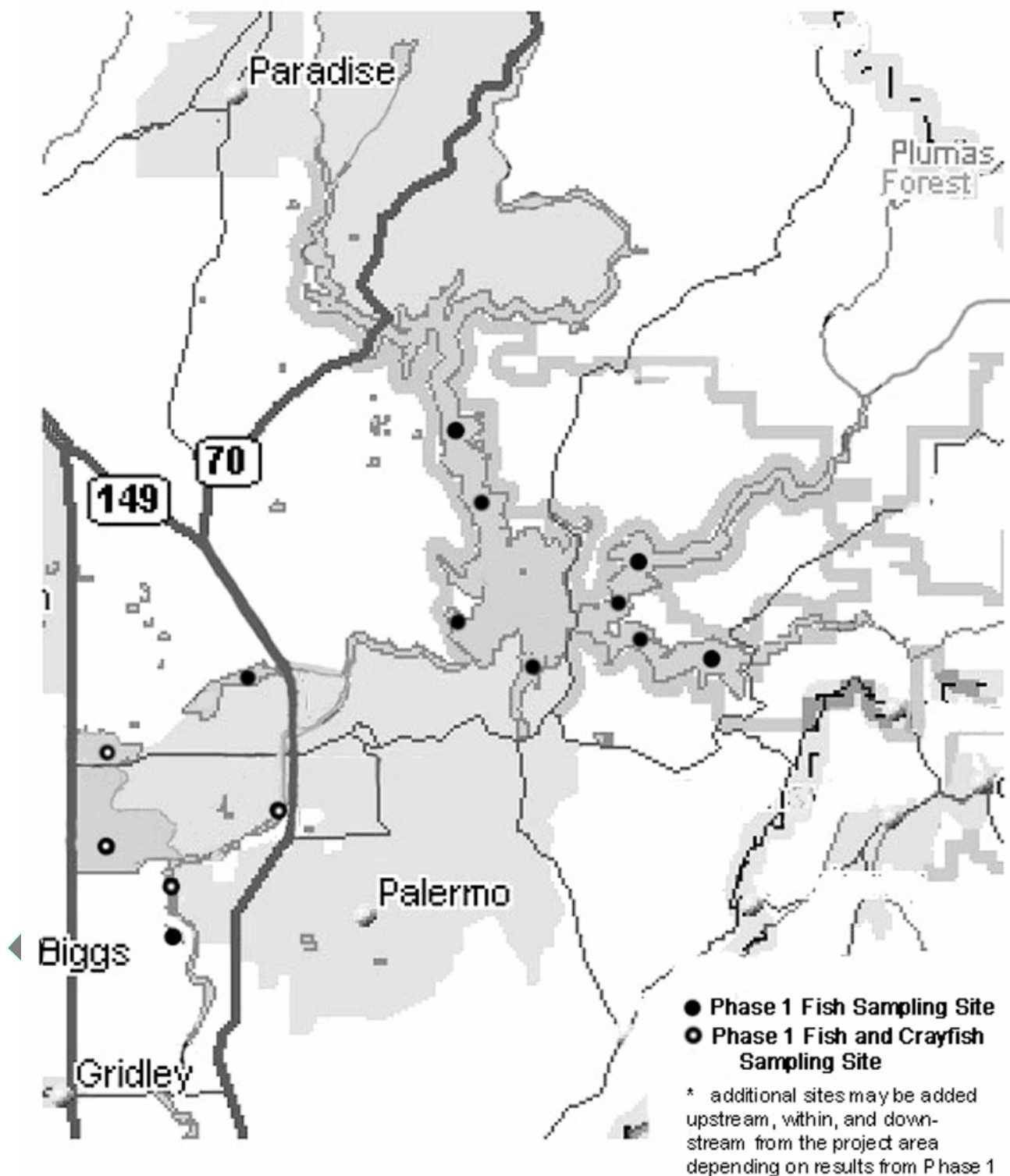


Figure SPW2. Task 1 Contaminant Monitoring Sites



Crayfish will be collected from the Thermalito Afterbay and either the low flow section or downstream from the Afterbay Outlet in the Feather River, depending on where they are found. Larger (older) crayfish will be targeted. At least ten crayfish of similar size from each site will be composited. Crayfish will be collected by hand, nets, or baited traps. Crayfish will be wrapped in aluminum foil and frozen for transport to the laboratory.

Lake Oroville — Screening for fish contamination in Lake Oroville requires multiple sampling sites in each arm and the main body of the reservoir. Fish will be collected from two different sampling sites in each of the North, Middle, and South fork arms and from both the east (Bidwell Marina arm) and west (Spillway arm) sides of the main body of the reservoir. In addition, bass and catfish will be collected from near the Lime Saddle Marina for polynuclear aromatic hydrocarbon contamination analysis. The marina environment is the most likely site for PAH accumulation. Targeted fish species will include spotted, largemouth, or smallmouth bass and channel catfish. Diversion Pool — The Diversion Pool will be sampled near the Diversion Dam. Fish targeted for collection from the Diversion Pool will include spotted, largemouth or smallmouth bass, and chinook or coho salmon. Crayfish will be collected from the same site.

- Thermalito Forebay, Thermalito Afterbay, and Oroville Wildlife Area — One monitoring site will be established in the north Thermalito Forebay. The Thermalito Afterbay will be sampled in both the northern and southern regions. . One representative pond will be sampled in the Oroville Wildlife Area. Warmwater fish species targeted in these water bodies will include spotted, largemouth, or smallmouth bass and channel catfish. Crayfish will be collected from both sampling areas in the Afterbay.
- Lower Feather River — The Feather River downstream from Oroville Dam will be sampled at one site in the low flow section between the fish hatchery and Afterbay Outlet and at another site downstream from the outlet within the project boundary.

Targeted fish species will include spotted, largemouth, or smallmouth bass and channel catfish. Attempts will be made to sample the same species as sampled in the other project waters. Crayfish will be collected from either the low flow section or downstream from the Afterbay Outlet in the Feather River..

Phase 1, Task 2—Laboratory Analyses

Analytical procedures generally will follow those used in the Toxic Substances Monitoring Program conducted by the State Water Resources Control Board and Department of Fish and Game. Metals, pesticides, polychlorinated biphenyls, and polynuclear aromatic hydrocarbons are analyzed for this program (Table SP-W2-1). PCB congeners analyzed will be those determined to pose significant ecological risks in a U.S. Environmental Protection Agency sponsored study (USEPA 1998), rather than just those analyzed as part of the TSMP.

Table SP-W2-1. Metals and Organic Contaminants for Analyses

| <u>Analyte</u> | <u>Reporting Limit ppb (ng/g)</u> | <u>Analyte</u> | <u>Reporting Limit ppb (ng/g)</u> |
|---|---------------------------------------|--------------------------------|---------------------------------------|
| <u>Organochlorine Pesticides by EPA Method 8081A</u> | | | |
| <u>aldrin</u> | <u>1</u> | <u>dieldrin</u> | <u>1</u> |
| <u>alpha-BHC</u> | <u>1</u> | <u>endosulfan I</u> | <u>2</u> |
| <u>beta-BHC</u> | <u>2</u> | <u>endosulfan II</u> | <u>2</u> |
| <u>gamma-BHC</u> | <u>1</u> | <u>endosulfan sulfate</u> | <u>2</u> |
| <u>delta-BHC</u> | <u>1</u> | <u>endrin</u> | <u>2</u> |
| <u>alpha-chlordane</u> | <u>1</u> | <u>endrin aldehyde</u> | <u>2</u> |
| <u>gamma-chlordane</u> | <u>1</u> | <u>endrin ketone</u> | <u>2</u> |
| <u>alpha-chlordene</u> | <u>1</u> | <u>heptachlor</u> | <u>1</u> |
| <u>gamma-chlordene</u> | <u>1</u> | <u>heptachlor epoxide</u> | <u>1</u> |
| <u>chlorpyrifos</u> | <u>2</u> | <u>Kelthane (dicofol)</u> | <u>2</u> |
| <u>chlorthal (dacthal)</u> | <u>2</u> | <u>methoxychlor</u> | <u>10</u> |
| <u>2,4'-DDD</u> | <u>2</u> | <u>mirex</u> | <u>2</u> |
| <u>2,4'-DDE</u> | <u>2</u> | <u>nonachlor, cis</u> | <u>2</u> |
| <u>2,4'-DDT</u> | <u>2</u> | <u>nonachlor, trans</u> | <u>2</u> |
| <u>4,4'-DCBP</u> | <u>2</u> | <u>oxadiazon</u> | <u>2</u> |
| <u>4,4'-DDD</u> | <u>2</u> | <u>oxychlordane</u> | <u>2</u> |
| <u>4,4'-DDE</u> | <u>2</u> | <u>tetradifon (tedion)</u> | <u>2</u> |
| <u>4,4'-DDT</u> | <u>2</u> | <u>toxaphene</u> | <u>100</u> |
| <u>4,4'-DDMU</u> | <u>2</u> | | |
| <u>Polynuclear Aromatic Hydrocarbons by EPA Method 8270C/SIM</u> | | | |
| <u>acenaphthene</u> | <u>10</u> | <u>fluoranthene</u> | <u>10</u> |
| <u>acenaphthylene</u> | <u>10</u> | <u>fluorene</u> | <u>10</u> |
| <u>anthracene</u> | <u>10</u> | <u>indeno(1,2,3-cd) pyrene</u> | <u>10</u> |
| <u>benzo(a)anthracene</u> | <u>10</u> | <u>3-methylcholanthrene</u> | <u>10</u> |
| <u>benzo(b, j&k)fluoranthene</u> | <u>10</u> | <u>1-methylnaphthalene</u> | <u>10</u> |

| <u>Analyte</u> | <u>Reporting Limit ppb (ng/g)</u> | <u>Analyte</u> | <u>Reporting Limit ppb (ng/g)</u> |
|---|---------------------------------------|--|---------------------------------------|
| benzo(g,h,i)perylene | 10 | 2-methylnaphthalene | 10 |
| benzo(a)pyrene | 10 | 1-methylphenanthrene | 70 |
| benzo(e)pyrene | 10 | naphthalene | 10 |
| biphenyl | 10 | perylene | 10 |
| chrysene | 10 | phenanthrene | 10 |
| dibenzo(a,h)anthracene | 10 | pyrene | 10 |
| 2,6-dimethylnaphthalene | 10 | 2,3,5-trimethylnaphthalene | 10 |
| Polychlorinated Biphenyls (PCB) Congeners by GC/ECD w/congener standards | | | |
| <u>Congener</u> | <u>Reporting Limit ppb (ng/g)</u> | <u>Congener</u> | <u>Reporting Limit ppb (ng/g)</u> |
| 8 | 0.6 | 128 | 0.6 |
| 15 | 0.6 | 132 | 0.6 |
| 18 | 0.6 | 137 | 0.6 |
| 27 | 0.6 | 138 | 0.6 |
| 28 | 0.6 | 149 | 0.6 |
| 29 | 0.6 | 151 | 0.6 |
| 31 | 0.6 | 153 | 0.6 |
| 44 | 0.6 | 156 | 0.6 |
| 49 | 0.6 | 157 | 0.6 |
| 52 | 0.6 | 158 | 0.6 |
| 66 | 0.6 | 167 | 0.6 |
| 70 | 0.6 | 169 | 0.6 |
| 74 | 0.6 | 170 | 0.6 |
| 77 | 0.6 | 174 | 0.6 |
| 81 | 0.6 | 177 | 0.6 |
| 87 | 0.6 | 180 | 0.6 |
| 95 | 0.6 | 183 | 0.6 |
| 97 | 0.6 | 187 | 0.6 |
| 99 | 0.6 | 189 | 0.6 |
| 101 | 0.6 | 194 | 0.6 |
| 105 | 0.6 | 195 | 0.6 |
| 110 | 0.6 | 200 | 0.6 |
| 114 | 0.6 | 201 | 0.6 |
| 118 | 0.6 | 203 | 0.6 |
| 123 | 0.6 | 206 | 0.6 |
| 126 | 0.6 | 209 | 0.6 |
| Organophosphorus Pesticides by EPA Method 8141A | | | |
| chlorpyrifos | 2 | parathion, ethyl | 2 |
| diazinon | 20 | parathion, methyl | 4 |
| Metals by EPA Method 6020 (ICPMS) | | | |
| arsenic* | 0.02 | mercury | 0.01 |
| cadmium | 0.005 | nickel | 0.01 |
| chromium | 0.1 | selenium* | 0.02 |

| <u>Analyte</u> | <u>Reporting Limit ppb (ng/g)</u> | <u>Analyte</u> | <u>Reporting Limit ppb (ng/g)</u> |
|--|---|----------------|---------------------------------------|
| <u>copper</u> | <u>0.006</u> | <u>silver</u> | <u>0.005</u> |
| <u>lead</u> | <u>0.007</u> | <u>zinc</u> | <u>0.06</u> |
| Miscellaneous Sediment Analyses | | | |
| <u>Percent organic carbon</u> | <u>EPA Method 9060</u> | | |
| <u>Acid volatile sulfides</u> | <u>EPA ABS/SEM procedures, Dec. 2, 1991</u> | | |
| <u>Nonyl phenols</u> | <u>GC-MS/DFG</u> | | |

** analysis with methanol addition*

Methylmercury is assumed to be the form of mercury available for bioaccumulation in the food web. Most mercury in fish tissues is in the methylmercury fraction. Total mercury, however, is typically analyzed from fish tissue and is assumed to represent the methylmercury content of tissues. Fish muscle (filet) tissue is analyzed for the metals arsenic, cadmium, nickel, mercury, and selenium, while fish liver is analyzed for copper, zinc, chromium, lead, and silver. All organic chemicals in fish are analyzed from filets. Whole body analyses of metals and organic chemicals are performed on crayfish. Insufficient information is available to determine whether total mercury analyses can be used to assess the methyl mercury fraction in crayfish. Therefore, both methyl and total mercury will be analyzed from crayfish to assess mercury contamination and the relationship between methyl and total mercury. Crayfish are shelled at the laboratory prior to analysis. All fish and crayfish analyses will be performed at the Department of Fish and Game Water Pollution Control Laboratory in Rancho Cordova.

The ten black bass obtained from each sampling site will be individually analyzed for total mercury contamination. Subsequently, five of the fish from each site will be composited following OEHHA guidelines. The black bass and catfish composites will be analyzed for organics (organochlorine and organophosphorus pesticides, and polychlorinated biphenyls) and metals. The composites of black bass and catfish collected near the Lime Saddle marina will be analyzed for polynuclear aromatic hydrocarbons in addition to organic and metal contaminants.

The composited crayfish samples from each sampling site will be analyzed for organic contaminants and ~~mercury~~ metals, including both methyl and total mercury.

Phase 1, Task 3 – Data Interpretation

Criteria and guidance values for protection of human health and wildlife from contaminant accumulation or ingestion will be researched and reviewed. Some of these criteria and guidance values include numerical criteria of the U.S. EPA and California Office of Environmental Health Hazard Assessment for human health protection, National Academy of Sciences predator protection criteria, maximum tissue residue levels and elevated data levels used by the SWRCB, action levels of the U.S. Food and Drug Administration, and median international standards for

trace elements of the Food and Agriculture Organization of the United Nations. Results from Task 2 will be compared to applicable criteria and guidance values. Potential pathways for bioaccumulation in the fish will be investigated for those contaminants present at levels that pose a concern. Pathways and sensitivity to contaminants in wildlife species of management concern will also be reviewed. This review will include evaluation of the potential for accumulation in their aquatic prey for contaminants identified in this study. The pathways investigation will facilitate determination of project operations that may contribute to contaminant bioaccumulation and downstream effects, and focus activities in Phase 2 of this study.

(Jerry – add language describing pathways chart – USFWS concern)

Phase 1, Task 4. Phase 1 Reports

Interim output products will be identified through coordination with other work groups to meet their data needs. A report will be prepared at the conclusion of Phase 1 of the study that discusses results of the study, including relationships to criteria and guidelines, implications for human and wildlife health, and need for Phase 2.

Phase 2—Metals and Organic Contaminant Assessment Pathways

If analyses in Phase 1 or findings of study plan SP-W1 demonstrate elevated levels in fish or crayfish (i.e., criteria or guidelines exceeded) or water quality conditions associated with enhanced bioaccumulation, a second phase will be undertaken. The Environmental Work Group, , will review and approve the Phase 2 approach before implementation. It is anticipated that Phase 2 could evaluate sediment, fish, and crayfish contamination in the tributaries to the reservoir to determine background (i.e., upstream) bioaccumulation and contamination levels. Additional sport fish species would be sampled in project waters to determine the extent of species affected. Sediments and prey fish species (such as threadfin shad or wakasagi preyed on by other fish and these and larger fish preyed on by wildlife species) may also be sampled for contaminants in project water bodies. In addition, sediment, fish, and crayfish would be sampled downstream from the project area in the Feather River to evaluate the extent of possible project effects on downstream contamination. Parameters analyzed would include both metals and organic contaminants that were found to be significant in Phase 1.

Phase 2, Task 1—Background Assessment

Analyses in Phase 2, Task 1 will focus on tributaries to the reservoir to provide background data needed to evaluate the role of the reservoir in bioaccumulation. Data from tributaries to the reservoir will be compared to that obtained from project waters to determine whether the project had any effect in bioaccumulation above background levels present in the watershed.

Phase 2, Task 1A—Sample Collection

Fish and crayfish species sample collection will use the same procedures and protocols as in Phase 1, Task 1. Fish and crayfish in the North, Middle, and South forks of the Feather River and the West Branch, Concow Creek, and Fall River will be sampled just above their confluences with the reservoir. Targeted fish species will include the same species sampled in Task 1-Phase 1. If those species are not available, targeted species may include smallmouth bass, catfish, and pikeminnow. (However, resampling of the reservoir would then be necessary to obtain the same species for comparisons).

Sediments will be collected from riffle deposits, point bars, or the bottom of pools. Sediments would be collected with teflon spoons into containers provided by the laboratory. Ten samples would be collected from each site and composited into a single sample. If deposited sediments are found to contain significant loads of contaminants, sediments in the bedload will be sampled for contaminants during the fall, winter, and spring to determine temporal variability in contamination and concentrations in sediments being transported into Lake Oroville.

Phase 2, Task 1B—Laboratory Analyses

Laboratory analyses for fish and crayfish will follow the same procedures as in Phase 1, Task 2. Sediments will be analyzed on a dry weight basis for metals, organic chemicals, percentage organic carbon, and acid volatile sulfides at the Cal-test Laboratory in Napa.

Phase 2, Task 1C—Data Interpretation

Data obtained from this Phase and Study Plan SP-W1 will be compared to criteria and guidelines to determine whether contaminant levels are present at levels that would pose a concern to human health, aquatic organisms, and the food web. Contaminant levels in fish and crayfish in the tributaries would be compared to levels in those species from project waters to determine whether the project contributed to additional bioaccumulation of contaminants in those species. The sediment data would be used to evaluate the contribution of contaminant loading from each tributary to focus future studies in the tributaries and reservoir.

Phase 2, Task 2—Project Waters Assessment

Analyses in Phase 2, Task 2 will focus on project waters to determine the extent of species affected by contamination, including additional sport fish species and prey species eaten by other fish and wildlife species. Additional fish species may also need to be collected if fish species collected from the tributaries in Phase 2, Task 1 are different than those collected in Phase 1 from project waters. The same species would be targeted from project waters in this Phase as collected in the tributaries in Phase 2 so comparisons can be made to discern the role of project waters in bioaccumulation.

Sediment samples would be collected from project waters to provide information on sources and loading potential.

~~Bottom sediments will be obtained with a core sampler during the spring to early summer prior to the development of anoxic conditions in the hypolimnion. Anoxic conditions allow some contaminants to recycle from sediments to the overlying water. The top six inches of sediments in the dredge will be collected with teflon spoons into containers provided by the laboratory. Ten core samples at each site will be composited into a single sample.~~

- ~~● Feather River Tributaries — Fish, crayfish, and sediments in the North, Middle, and South forks of the Feather River and the West Branch, Concow Creek, and Fall River will be sampled just above their confluences with the reservoir. Targeted fish species will include rainbow trout, smallmouth bass, and pikeminnow. Sediments will be collected from riffle deposits or the bottom of pools. If deposited sediments are found to contain significant loads of metals or organic contaminants, sediments in the bedload will be sampled for contaminants during the fall, winter, and spring to determine temporal variability in contamination and concentrations in sediments being transported into Lake Oroville.~~

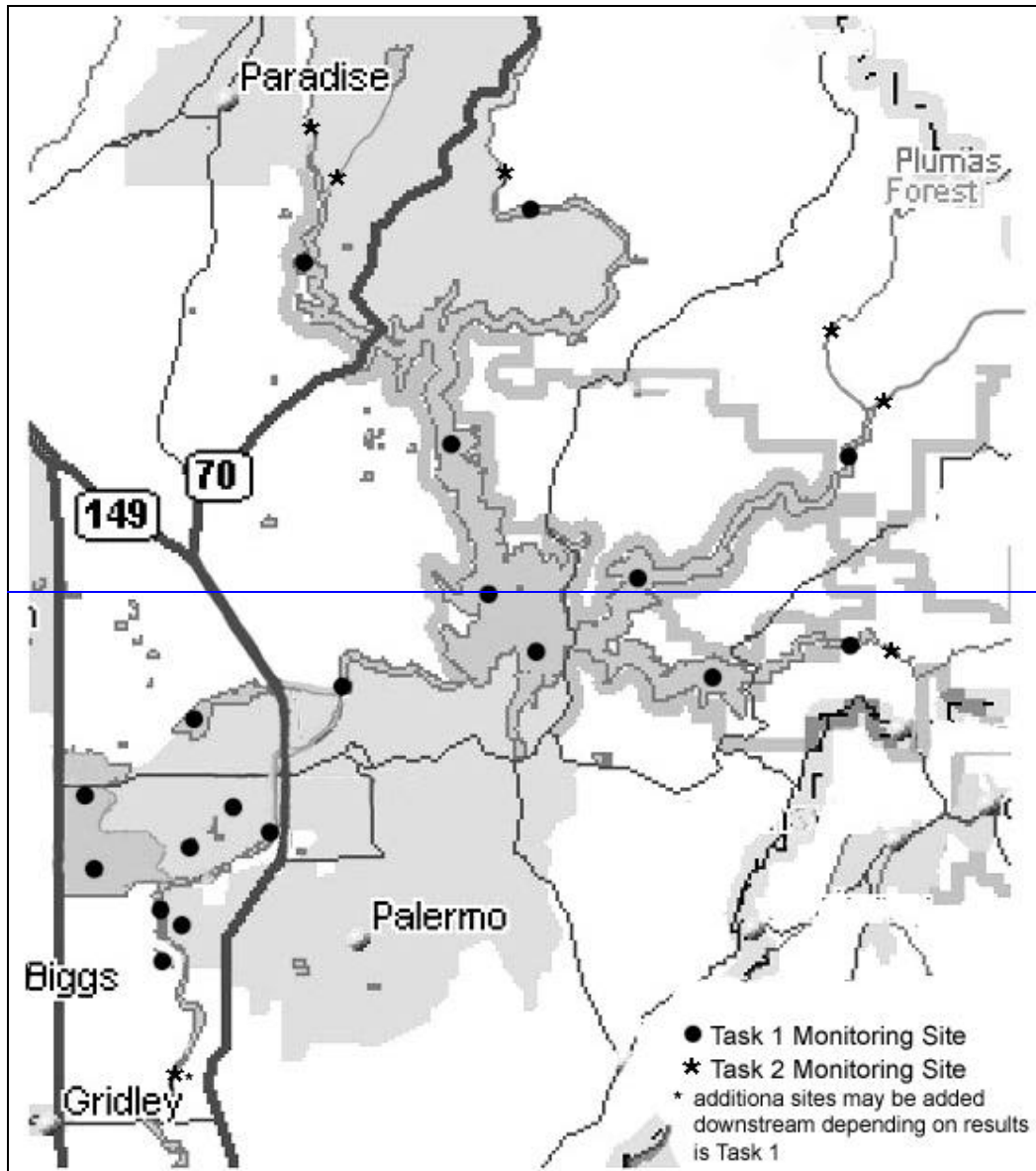
~~2.~~

- ~~● Lake Oroville — Sediments will be collected from the same sites from which fish and crayfish were sampled in Task 1. Additional sites for sediment samples may be necessary in the main body of the reservoir due to the areal extent and potential for different loading from each arm of the reservoir. The need to collect additional samples will be determined by the variability found in the initial samples.~~

~~Prey fish species (threadfin shad and wakasagi) in the reservoir may be sampled if high contaminant loads are found in fish that prey on them in Task 1. If necessary, these species will be collected with gill nets or seines.~~

- ~~● Diversion Pool — Sediments will be collected from the Diversion Pool at the same site selected for fish and crayfish sampling in Task 1.~~

Task 1 and 2 Contaminant Monitoring Sites



• Thermalito Forebay, Thermalito Afterbay, and Oroville Wildlife Area—Sediments will be sampled in these water bodies in the same areas from which fish and crayfish were sampled.

• Lower Feather River—Sediments will be collected from riffle deposits or from the bottom of pools in the previously sampled sites in the low flow section of the river and downstream from the Afterbay Outlet in the project area. Additional sites may be necessary to sample downstream from the Afterbay Outlet as far downstream as the mouth of the Feather River if significant contamination is found in fish, crayfish, or sediments to determine the extent of effect to contamination from the project. The

necessity for sampling downstream from the project area will be determined after results from Task 1 are reviewed in consultation with State and federal agency staffs.

Task 2B—Sample Analysis

Analyses, laboratories, and procedures for fish and crayfish analyses will be the same as in Task 1. Sediments will be analyzed for metals, organic chemicals, percentage organic carbon, and acid volatile sulfides at the Cal test Laboratory in Napa.

6.0—Results and Products/Deliverables

Results

Information from this study will be used to evaluate the effects of the project and project operations on contamination in sediments and bioaccumulation of contaminants in fish and crayfish. Information developed will be presented quarterly to the Environmental Workgroup and Task Force for review to evaluate the adequacy and progress of the study.

Data obtained from this study will be compared to numerical criteria of the U.S. EPA and California Office of Environmental Health Hazard Assessment for human health concern, and National Academy of Sciences predator protection criteria. Additional criteria used for evaluation of the data will include maximum tissue residue levels developed by the SWRCB, action levels of the U.S. Food and Drug Administration, median international standards for trace elements of the Food and Agriculture Organization of the United Nations, and elevated data levels of the SWRCB. Data will be presented in tables and graphs showing the relationship between concentrations of any contaminants found and the various criteria.

Compliance with criteria will be used to evaluate compliance with Basin Plan objectives, which is necessary for the SWRCB to issue a water quality certification. The water quality certification must be submitted to the Federal Energy Regulatory Commission with the application for a new license for the project.

A draft report documenting findings will be prepared after completion of Task 1, and a final report with results and recommendations will be prepared at the completion of Task 2, if necessary.

7.0—Coordination and Implementation Strategy

Coordination with Other Resource Areas/Studies

This study will provide information for evaluation of Issue Sheet W6 (effect of existing and future project facilities and operations on sediment deposition and potential impoundment of metals and toxins, including the potential presence and uptake of methylmercury through the food chain) and will be coordinated with Study Plan SPG1 (Geology Issue G4—project effect on sediment accumulation upstream of the dam). Information derived from SPG1 will be used to determine the magnitude of potentially contaminated sediment influx into the reservoir.

Issues, Concerns, Comments Tracking, and/or Regulatory Compliance Requirements

- W6—Effect of existing and future project facilities and operations on sediment deposition and potential impoundment of metals and toxins, including the potential presence and uptake of methylmercury through the food chain.

Lake Oroville, fed by tributaries that have a history of gold mining activity, has potential for accumulation of elemental mercury in its basin sediments. The following Issues will also be addressed: WE7, WE13, WE41, G4, and F6.

8.0—Study Schedule

The study will begin in the spring of 2002. Collection of samples necessary for analyses of the significance of metals and organic contamination in fish and crayfish in project waters (Task 1) should be completed by early summer of 2002. If necessary, additional samples to determine effects from tributary contributions, sediment loads, and downstream effects would occur the following year. Additional samples may be necessary in subsequent years if sampling attempts fail to collect the requisite samples or if particularly contaminated samples are encountered. A draft report discussing sampling, analytical results, project implications, and recommendations will be completed at the end of each study year.

Phase 2, Task 2A—Sample Collection

Fish species sample collection will use the same procedures and protocols as in Phase 1, Task 1. Sediment samples from deeper project water bodies (e.g., Lake Oroville, Thermalito Afterbay) would be obtained with a core sampler during the spring to early summer prior to the development of anoxic conditions in the hypolimnion. Anoxic conditions allow some contaminants to recycle from sediments to the overlying water. The top six inches of sediments in the sampler will be collected with teflon spoons into containers provided by the laboratory. Ten core samples at each site will be composited into a single sample. Sediments would be collected in the Feather River downstream from the dam within the project area from deposits (point bars, riffle areas, or pools) with teflon spoons into containers provided by the laboratory. Ten samples would be collected from each site and composited into a single sample.

•
Lake Oroville — Fish and sediments will be collected as much as possible from the same sites from which fish and crayfish were sampled in Phase 1. Additional sport fish targeted for sampling include brown trout, chinook or silver salmon, bass, and sunfish (including those species sampled in Phase 1). Prey fish species (threadfin shad and wakasagi) in the reservoir may be sampled if high contaminant loads are found in Phase 1 in fish that prey on them. Fish will be analyzed using the procedures in Phase 1 for information related to human health from ingestion of contaminated fish as well as whole body analyses of fish for evaluation of effects to wildlife species. Additional sites for sediment samples may be necessary in the main body of the reservoir due to the areal extent and

potential for different loading from each arm of the reservoir. The need to collect additional samples will be determined by the variability found in the initial samples..

- Diversion Pool — Fish and sediments will be collected from the Diversion Pool near the Diversion Dam. Sport fish targeted for sampling include rainbow and brown trout, catfish, bass, and sunfish. Fish will be analyzed both for information related to human health from ingestion of contaminated fish as well as whole body analyses of fish for evaluation of effects to wildlife species.
- Thermalito Forebay, Thermalito Afterbay, and Oroville Wildlife Area — Sediments will be sampled in these water bodies in the same areas from which fish and crayfish were sampled in Phase 1. Sport fish targeted for sampling include rainbow and brown trout, catfish, bass, and sunfish. Analyses will include both fish tissues analysis for evaluation of effects to human health and whole body analysis for evaluation of effects to wildlife.
- Lower Feather River — Sediments will be collected in the previously sampled sites in the low flow section of the river and downstream from the Afterbay Outlet in the project area. Fish targeted for sampling will include bass, catfish, and sunfish. As with the other sampling sites, fish analyses will include specific tissues and whole body analyses for determination of effects to human health and wildlife species, respectively.
- The vulnerability of piscivorous wildlife species to bioaccumulated contaminants will be evaluated in the terrestrial studies if fish eaten as prey are found to contain high levels of contaminants. The assessment of piscivorous susceptibility will be evaluated through a literature review of effects from the specific contaminants identified in this study as occurring in significant concentrations in prey species.

Phase 2, Task 2B—Laboratory Analyses

Analyses, laboratories, and procedures for fish and sediment analyses will be the same as in the previous Phases.

Phase 2, Task 2C—Data Interpretation

Data obtained from this Task will be compared to criteria and guidance values to determine the extent of contamination of fish species, need for advisories or additional information, and effects to wildlife species. The data will also be evaluated to identify potential pathways for bioaccumulation, including contaminant loading, deposition, and cycling.

Phase 2, Task 3. Lower Feather River

This Phase of the study would determine the extent of project related impacts to fish, crayfish, and sediments downstream from the project area. Parameters analyzed would include both metals and organic contaminants that were found to be significant in Phase 1.

Phase 2, Task 3A—Sample Collection

Fish, crayfish, and sediment sample collection will use the same procedures and protocols as in previous Phases which are appropriate for stream sampling. Methods used will avoid species of concern. Targeted species include bass, catfish, and sunfish. Analyses will include tissue analyses for determination of effects to human health as well as whole body analyses to determine effects to wildlife species.

Phase 2, Task 3B— Laboratory Analyses

Analyses, laboratories, and procedures for fish and sediment analyses will be the same as in the previous Phases.

Phase 2, Task 3C—Data Interpretation

Data from this Phase will be evaluated to determine the extent of project related effects to fish, crayfish, and sediments downstream from the project area. The data will be compared to criteria and guidance values researched in Phase 1.

Phase 2, Task 4. Phase 2 Reports

Interim output products will be identified through coordination with other work groups to meet their data needs. A report will be prepared at the conclusion of Phase 2 of the study that discusses results of the study, including relationships to criteria and guidelines, implications for human and wildlife health, role of the project, and potential protection, mitigation, and enhancement measures.

6.0 Results and Products/Deliverables

ResultsInformation from this study will be used to evaluate the effects of the project and project operations on contamination in sediments and bioaccumulation of contaminants in fish and crayfish. Information developed will be presented quarterly to the Environmental Work roup and Task Force for review to evaluate the adequacy and progress of the study.

Data obtained from this study will be compared to criteria and guidelines established for the protection of human health, fish, and wildlife species. Data will be presented in tables and graphs showing the relationship between concentrations of any contaminants found and the various criteria and guidance values.

Compliance with criteria guidance values will be used to evaluate compliance with Basin Plan objectives, which is necessary for the SWRCB to issue a water quality certification. The water quality certification must be submitted to the Federal Energy Regulatory Commission with the application for a new license for the project.

A draft report documenting findings will be prepared after completion of Phase 1, and a final report with results and recommendations will be prepared at the completion of subsequent Phases, if necessary. The draft report following completion of Phase 1 will include information about potential risks to wildlife from ingestion of contaminated fish species for evaluation in the terrestrial studies.

7.0 Coordination and Implementation Strategy

Coordination with Other Resource Areas/Studies

This study will provide information for evaluation of Issue Sheet W6 (effect of existing and future project facilities and operations on sediment deposition and potential impoundment of metals and toxins, including the potential presence and uptake of methylmercury through the food chain) and will be coordinated with Study Plan SPG1 (Geology Issue G4 - project effect on sediment accumulation upstream of the dam). Information derived from SPG1 will be used to determine the magnitude of potentially contaminated sediment influx into the reservoir.

Issues

This study plan provides the information for evaluation of Issue Statement W6 (effect of existing and future project facilities and operations on sediment deposition and potential impoundment of metals and toxins, including the potential presence and uptake of methylmercury through the food chain. Lake Oroville, fed by tributaries that have a history of gold mining activity, has potential for accumulation of elemental mercury in its basin sediments). This study directly or indirectly addresses the following specific issues:

Direct

- WE 7. Lake Oroville, fed by tributaries that have a history of gold mining activity, has potential for accumulation of elemental mercury in its basin sediments. Potential presence and uptake of methylmercury through the food chain must be assessed
- F6. Effects of existing and future project operations on sediment deposition, erosion, and recruitment through the system (including downstream sediment supply) and associated changes in water quality on the quantity and quality of aquatic habitats within project affected waters.

Indirect

- WE 13. Reduce sediment yields from watersheds in deteriorating conditions and those tributary to eroding channels or hazardous flood prone areas
 - WE 41. What coordination for Page 2 #5? -- Could be items along roads that might sweep into the river during floods.
 - G4. Project effects on sediment accumulation upstream of the dam.
- (Expanded Issues Addressed: GE19, GE22, W6, W9)

8.0 Study Schedule

The study will begin in the spring of 2002. Collection of samples necessary for analyses of the significance of metals and organic contamination in fish and crayfish in project waters (Phase 1) should be completed by early summer of 2002. If necessary, additional samples to determine effects from tributary contributions, sediment loads, and downstream effects would occur later in 2002 or the following year. Additional samples may be necessary in subsequent years if sampling attempts fail to collect the requisite samples or if particularly contaminated samples are encountered. A draft report discussing sampling, analytical results, project implications, and recommendations will be completed at the end of each phase of the study.

SP-W5 Project Effects on Groundwater

~~March 141, 2002~~ March 1927, 2002

1.0 Introduction/Background

Relicensing participants raised a concern about the effects of the project features and operations on groundwater quality downstream from the Oroville dDam. Included in their concern are project-related effects to hyporheic zones along the Feather River, project reservoir and Feather River water quality and levels in the project area on groundwater quality and quantity, including hyporheic zone interactions. The “hyporheic zone” comprises the interstices or spaces in the mixture of coarse sand, gravel, and other rocks beneath and beside a river or stream. The spaces are permeated by flowing water in contact with that in the stream, and are inhabited by a variety of insects and other aquatic organisms, including fish fry.

Oroville dDam and Lake OrovilleR are underlain by relatively impermeable Mesozoic-era igneous bedrock. Downstream from the dam, the Feather River and the Thermalito Forebay and Afterbay project features are on much younger and more permeable volcanoclastic and alluvial sediments, where groundwater recharge occurs. Due to the porosity of the underlying deposits, the hydraulic heads of the Thermalito Forebay and Afterbay surface water features, as well as varied project-related releases to the Feather River, probably contribute to locally higher groundwater levels, though the extent of this effect has not been quantified. It is possible also that groundwater quality locally reflects the characteristics of the water within these project features.

Creation of Lake Oroville likely has had little effect on groundwater, since the reservoir is underlain by hard rock that does not transmit water in any appreciable quantity. However, the Thermalito Forebay and Afterbay exert significant hydraulic head that increases recharge downgradient from these water bodies. were constructed in areas that do contribute to groundwater recharge. The hydraulic head from these reservoirs could contribute to higher groundwater levels in the affected area, though the extent of this impact has not been quantified. In addition, higher flows in the Feather River during project related releases could also contribute to groundwater recharge. Recharge to groundwater from the Thermalito Forebay and Afterbay and Feather River may also differ in quality than that occurring naturally from rainfall percolation.

Existing and future operation of the Oroville Facilities may have effects on the physical, chemical, and biological components of groundwater quality in the project area. Some physical, chemical, and biological data have been collected from groundwater in the project area. However, these data are not, nor were they expected to be, sufficient to determine compliance with Basin Plan criteria, goals, and objectives (CVRWQCB 1998) for established for protection of groundwater beneficial uses. Additional physical, chemical, and biological data are needed to demonstrate project compliance with Basin Plan objectives standards for groundwater.

2.0 Study Objectives

The objectives of this study are to quantify the localized effects on groundwater levels and groundwater quality from Thermalito Forebay and Afterbay operations, as well as from dam releases to the Feather River. The study will include quantifying effects on movement of water within hyporheic zones and determining the hydraulic connectivity between the Feather River and ponds within the Oroville Wildlife Area.) ~~The objectives of the study are to evaluate the effects of project features and operations of the Thermalito Forebay and Afterbay and the Feather River in the project area on groundwater quality and levels, and the effects of subsurface movement on the hyporheic zone and its connectivity with ponds in the Oroville Wildlife Area.~~

3.0 Relationship to Relicensing /Need for the Study

Construction of Oroville Dam, impoundment of water to form Lake Oroville, and associated facilities of the project have affected the physical, chemical, and biological characteristics of water in the Feather River. Since the Feather River provides recharge to local groundwater, these changes in water quality characteristics in the river may subsequently affect groundwater characteristics. In addition, recharge to groundwater from the Thermalito Forebay and Afterbay may affect groundwater quality as well as levels. Ponds in the Oroville Wildlife Area are likely hydraulically connected to the Feather River, and thus may also be affected by the water quality characteristics of the Feather River.

Though the project may potentially affect biological characteristics of groundwater, aquatic macroinvertebrates as a component of the biological characteristics of groundwater are not included for study since sufficient information about these organisms is being obtained from riffle areas of the Feather River in Study Plan SP-W1. However, if information from this study suggests that there may be adverse effects to the biological hyporheic element, then studies will be developed in collaboration with the Environmental Workgroup and Task Force to examine those effects.

Prior to issuance of a new license for the project, the Federal Energy Regulatory Commission ([FERC](#)) will require a water quality certification by the State Water Resources Control Board (SWRCB). The certification requires a determination by the SWRCB that the project complies with appropriate requirements of the Central Valley Regional Water Quality Control Board (CVRWQCB) Basin Plan, which includes water quality objectives for protection of designated beneficial uses. The CVRWQCB has established groundwater quality objectives for bacteria, chemical constituents, radioactivity, tastes and odors, and toxicity.

Information obtained from the study will be used to determine project effects to the physical, chemical, and biological components of groundwater, demonstrate compliance with water quality standards and other appropriate requirements in the application for water quality certification, and identify the need for project modification or mitigation for impacts to groundwater quality or levels from project operations. Water quality analysis is required for determination of conditions in the water quality certification by the SWRCB. **The Federal Energy Regulatory Commission (FERC) requires**

4.0 Study Area

The study will include areas where groundwater is anticipated to be affected by project features and one or more reference sites up gradient from potential project effects. These include areas adjacent to the west and south of the Thermalito Forebay, areas adjacent to the west, south and east of the Thermalito Afterbay, and areas along the Feather River, from the Fish Barrier Dam to the southern boundary of the Oroville Wildlife Area. ~~The study area is generally within the FERC project boundary, but also includes adjacent areas for project related effects. The specific area of study is the groundwater generally downgradient from the Thermalito Forebay and Afterbay and the Feather River, and ponds within the Oroville Wildlife Area. Measurement of the effects of the project on groundwater will require monitoring groundwater quality and levels in areas adjacent to the project, including farmland adjacent to the Afterbay.~~

Study plans approved by the Environmental Work Group define the limits of the study area. If initial study results indicate that the study area should be expanded or contracted, the Environmental Work Group will discuss the basis for change and revise the study area as appropriate.

5.0 General Approach

Detailed Methodology and Analysis Procedures

This study will evaluate effects from project features to groundwater and hyporheic zones along the Feather River. Effects to groundwater levels and quality will be conducted in phases. The first phase will review current groundwater monitoring data to determine whether sufficient data are available to evaluate project effects to groundwater. If sufficient data are not available, a subsequent phase will obtain the necessary information. ~~Surface water quality information from the Thermalito Forebay and Afterbay and Feather River downstream from the dam collected in Study Plan SPW1#SP-W1 will be compared with groundwater quality downgradient from these areas and in surrounding areas to assess effects from the project. Groundwater levels will be monitored to determine hydraulic connectivity and potential effects from the project to area groundwater levels and pond levels in the Oroville Wildlife Area. If initial study results indicate that the methods and tasks should be modified, the Environmental Work Group will discuss the basis for change and revise the study plans as appropriate.~~

Task 1, Phase 1—Inventory Existing Wells and ~~Scrutiny~~Assessment of Existing Groundwater Data and Current Groundwater Monitoring Activities

An inventory of wells located in the specified field areas will be made utilizing records maintained at the California Department of Water Resources (DWR). Shallow wells (100 feet deep or less) will be identified for use in this study because potential impacts to groundwater from the Thermalito project features would likely occur in a shallow, unconfined setting. Available logs for these wells will be reviewed to ensure a general consistency of subsurface materials was encountered during drilling. Logs of deeper wells and logs of wells that indicate substantially different and varying earth materials that were encountered during drilling will be set aside for possible more intensive lithologic and hydrogeologic interpretation, if needed. Wells will be categorized according to location, surface elevation, depth, design, and use; this data will then be entered

into a GIS database. This will allow the data to be presented graphically in a variety of ways, and will allow the inclusion of additional data collected subsequently.

Monitoring of groundwater levels and groundwater quality in some wells within the field areas is being conducted by DWR as part of its ongoing groundwater monitoring program for the DWR Northern District. In addition, a number of monitoring wells were constructed shortly after completion of the project to evaluate the effects on groundwater levels of seepage from the Afterbay and pumps installed to collect the seepage. These data and other available groundwater level and groundwater quality data from the selected wells will be collected from DWR and CVRWQCB records and other sources, such as cooperative well owners. The compiled data will be reviewed and compared as appropriate to surface water level and surface water quality data collected from the Thermalito Forebay and Afterbay as part of the Oroville Facilities FERC Study Plan SP-W-1 (Project Effects on Water Quality Designated Beneficial Uses for Surface Waters). Other available and appropriate data collected from these surface water features will also be compared to the available well data.

The groundwater level data from the wells will be scrutinized to determine if there appear to be localized effects on the water table from the Thermalito Forebay and Afterbay. It is anticipated that a mounding of the water table will be evident from the groundwater level data. The Ground Water Model of Butte County will be reviewed and may be used to help identify project effects to water levels. Similarly, groundwater quality data will be compared to the water quality of the Thermalito project features to determine if the surface water features are affecting groundwater quality.

Relevant data in the project area from the existing groundwater level and quality monitoring program of the Northern District of ~~DWR~~ the California Department of Water Resources (DWR) will be collated. Well locations from the monitoring program will be plotted on GIS maps. The monitoring data will be reviewed to determine whether suitable data are being collected for use in this study, and the need to collect additional monitoring information for both groundwater levels and quality.

Task Task 1, Phase 2—Groundwater Monitoring

Some of the existing wells within the identified field areas for this study are currently monitored by the DWR as part of its groundwater level and groundwater quality monitoring program for the DWR Northern District. Wells monitored in this program are measured during the spring, summer (July and August), and fall for water levels, and biennially during the summer for water quality. If available data, including data from this existing monitoring program, are not sufficient to determine effects from the Thermalito project features to groundwater, then additional monitoring may be necessary. Additional monitoring may necessitate the construction of additional wells and/or piezometers. Frequency of additional groundwater level monitoring and degree of the groundwater quality analysis will depend on findings in Phase 1.

Should additional monitoring be necessary, groundwater levels will be measured in monitoring wells and piezometers, and in pumping wells that have been inactive for one week or more. Active pumping wells will not be measured or sampled. In general, groundwater level and groundwater quality sampling will be conducted in the spring, summer, and fall. Should groundwater samples be collected for additional monitoring, they will be analyzed for general mineral composition and physical parameters such as pH, conductivity, and temperature at the time of sampling. The general mineral analysis will enable the ionic composition of the

groundwater to be compared with the ionic signature of water collected from the Thermalito features in Study Plan SP-W1. Similarly, the physical parameters of the groundwater samples can be compared to surface water samples from the Thermalito features.

Depending on comparison results, the groundwater samples may also be analyzed for a suite of parameters similar to those for which surface water samples will be analyzed as part of Study Plan SP-W1, including methyl tert-butyl ether (MTBE), total and fecal coliform bacteria, metals, and select pesticides. Table SP-W5-1 is a list of these potential analytes and corresponding EPA-approved analytical methodology. Chemical analyses for minerals, nutrients, metals, pesticides, and total dissolved solids would be performed at the DWR Bryte Chemical Laboratory in West Sacramento, California. Analyses for total and fecal coliform bacteria would be conducted by the DWR laboratory in Red Bluff, California.

If data from the existing monitoring program are not sufficient to determine effects from the project to groundwater, then ~~current monitoring wells and possibly other suitable existing wells~~ will be identified for additional monitoring. ~~Well S logs maintained by DWR will be reviewed to identify potential groundwater monitoring wells. Well logs will be obtained for both shallow and deeper wells. The well logs will be reviewed to assure that wells selected for monitoring are perforated within the desired groundwater zone. If insufficient suitable existing wells are found, monitoring wells will be constructed to obtain information on groundwater quality and levels. Wells in areas both influenced and likely not to be influenced by recharge from the project will be monitored so as to be able to determine the degree of effect in affected areas. Influence of the project on groundwater quality will be determined by analysis of data from existing wells immediately adjacent to the project facilities and at increasing distances from the facilities until little change in quality becomes apparent (i.e., background water quality). All irrigation and domestic wells for sampling from the area will be surveyed for elevation and will be plotted on GIS maps. Wells will be selected for monitoring that will characterize the horizontal and vertical quality and levels of groundwater in the area.~~

Groundwater levels will be measured during the spring and again in the fall. Levels will be measured following a period when the wells have not been used. Any data on groundwater levels being monitored by others will also be compiled.

Groundwater quality information will be collected during the summer. Depth to water in each selected well will be measured, and the well purged prior to collection of water quality samples. Purging will involve running the well pump with periodic measurements of conductivity, temperature, and pH. When these parameters have been stable between at least three successive measurements taken at least five minutes apart, water samples for chemical analyses will be obtained. Parameters analyzed will include minerals, nutrients, metals, pesticides, MTBE, hardness, total dissolved solids, conductivity, pH, temperature, and total and fecal coliform bacteria to determine existing area groundwater quality and changes to groundwater quality induced by the project. Potential changes may be either negative or positive, such as contributing metals to groundwater or diluting pesticide contamination of groundwater acquired from other sources, respectively.

Water temperature will be measured using a calibrated thermometer or thermistor. Conductivity and pH will be measured with calibrated meters and probes. Mineral and nutrient samples will be collected into clean polyethylene containers. Samples for trace metals analyses at water quality criteria levels will be collected into

polyethylene or glass bottles according to U.S. EPA Method 1669. Chemical analyses of minerals, nutrients, metals, pesticides, and total dissolved solids will be performed at the DWR Bryte Chemical Laboratory in West Sacramento using U.S. EPA approved techniques, equipment, and methods (Table SPW5-1). Total and fecal coliform will be analyzed at the DWR laboratory in Red Bluff.

Table SP-W5-1. Analytical methods and detection levels

| Method | Analysis | Units | Reporting Limit |
|---|-------------------------------|-------------------------|-----------------|
| Minerals | | | |
| EPA 200.7 (D) | Dissolved Calcium | mg/L | 1 |
| EPA 200.7 (D) | Dissolved Sodium | mg/L | 1 |
| EPA 200.7 (D) | Dissolved Potassium | mg/L | 0.5 |
| EPA 200.7 (D) | Dissolved Magnesium | mg/L | 1 |
| EPA 300.0 (28d hold) | Dissolved Sulfate | mg/L | 1 |
| EPA 300.0 28d Hold | Dissolved Chloride | mg/L | 1 |
| EPA 200.7 (D) | Dissolved Boron | mg/L | 0.1 |
| Std Method 2320 B | Alkalinity | mg CaCO ₃ /L | 0.1 |
| Nutrients | | | |
| Std Method 4500-NO ₃ -F Modified | Dissolved Nitrite + Nitrate | mg/L as N | 0.05 |
| EPA 350.1 | Dissolved Ammonia | mg/L as N | 0.02 |
| Std Method 4500-NH ₃ | Total Ammonia | mg/L as N | 0.02 |
| EPA 365.1 | Dissolved Ortho-phosphate | mg/L as P | 0.01 |
| EPA 365.4 | Total Phosphorus | mg/L | 0.01 |
| Metals | | | |
| EPA 1631 | Total Mercury | ug/L | 0.0002 |
| EPA 1631 | Total Methyl Mercury | ug/L | 0.005 |
| EPA 1632 | Total and Dissolved Arsenic | ug/L | 0.004 |
| Std Method 3500-Fe D | Total and Dissolved Iron | ug/L | 2.2 |
| EPA 1638 | Total and Dissolved Aluminum | ug/L | 0.4 |
| EPA 1638 | Total and Dissolved Cadmium | ug/L | 0.003 |
| EPA 1638 | Total and Dissolved Chromium | ug/L | 0.03 |
| EPA 1638 | Total and Dissolved Copper | ug/L | 0.01 |
| EPA 1638 | Total and Dissolved Lead | ug/L | 0.005 |
| EPA 1638 | Total and Dissolved Manganese | ug/L | 0.02 |
| EPA 1638 | Total and Dissolved Nickel | ug/L | 0.01 |
| EPA 1638 | Total and Dissolved Selenium | ug/L | 0.1 |
| EPA 1638 | Total and Dissolved Zinc | ug/L | 0.03 |

| | | | |
|---------------------------------------|-------------------------|---------------------------|------|
| | | | |
| Miscellaneous | | | |
| Std Method 2540 C | Total Dissolved Solids | mg/L | 1 |
| Std Method 2340 B | Hardness | mg/L as CaCO ₃ | 1 |
| Std Method 2550 B 1 | Temperature | degree Celcius | 0.1 |
| Std Method 4500-O C | Dissolved oxygen | mg/L | 0.1 |
| Std Methods 4500-H+ B | pH | pH units | 0.1 |
| Std Method 2510 B | Conductivity | umhos/cm | 0.1 |
| | | | |
| Pathogens | | | |
| Std Method 9222 B | Total Coliform bacteria | colonies/100 mL | 0 |
| Std Method 9222 D | Fecal Coliform bacteria | colonies/100 mL | 0 |
| | | | |
| Pesticides | | | |
| Chlorinated Organic Pesticides | | | |
| EPA 508 | Alachlor | ug/L | 0.05 |
| EPA 508 | Aldrin | ug/L | 0.01 |
| EPA 508 | Atrazine | ug/L | 0.02 |
| EPA 508 | BHC-alpha | ug/L | 0.01 |
| EPA 508 | BHC-beta | ug/L | 0.01 |
| EPA 508 | BHC-delta | ug/L | 0.01 |
| EPA 508 | BHC-gamma (Lindane) | ug/L | 0.01 |
| EPA 508 | Captan | ug/L | 0.02 |
| EPA 508 | Chlordane | ug/L | 0.05 |
| EPA 508 | Chlorothalonil | ug/L | 0.01 |
| EPA 508 | Chlorpropham | ug/L | 0.02 |
| EPA 508 | Chlorpyrifos | ug/L | 0.01 |
| EPA 508 | Cyanazine | ug/L | 0.3 |
| EPA 508 | Dacthal (DCPA) | ug/L | 0.01 |
| EPA 508 | Dichloran | ug/L | 0.01 |
| EPA 508 | Dicofol | ug/L | 0.05 |
| EPA 508 | Dieldrin | ug/L | 0.01 |
| EPA 508 | Diuron | ug/L | 0.25 |
| EPA 508 | Endosulfan sulfate | ug/L | 0.02 |
| EPA 508 | Endosulfan-I | ug/L | 0.01 |
| EPA 508 | Endosulfan-II | ug/L | 0.01 |
| EPA 508 | Endrin | ug/L | 0.01 |
| EPA 508 | Endrin aldehyde | ug/L | 0.01 |
| EPA 508 | Heptachlor | ug/L | 0.01 |

| | | | |
|-------------------------------|---------------------------------|------|------|
| EPA 508 | Heptachlor epoxide | µg/L | 0.01 |
| EPA 508 | Methoxychlor | µg/L | 0.05 |
| EPA 508 | Metolachlor | µg/L | 0.2 |
| EPA 508 | Oxyfluorfen | µg/L | 0.2 |
| EPA 508 | p,p'-DDD | µg/L | 0.01 |
| EPA 508 | p,p'-DDE | µg/L | 0.01 |
| EPA 508 | p,p'-DDT | µg/L | 0.05 |
| EPA 508 | PCB-1016 | µg/L | 0.1 |
| EPA 508 | PCB-1221 | µg/L | 0.1 |
| EPA 508 | PCB-1232 | µg/L | 0.1 |
| EPA 508 | PCB-1242 | µg/L | 0.1 |
| EPA 508 | PCB-1248 | µg/L | 0.1 |
| EPA 508 | PCB-1254 | µg/L | 0.1 |
| EPA 508 | PCB-1260 | µg/L | 0.1 |
| EPA 508 | Pentachloronitrobenzene (PCNB) | µg/L | 0.01 |
| EPA 508 | Ronnel | µg/L | 0.3 |
| EPA 508 | Simazine | µg/L | 0.02 |
| EPA 508 | Thiobencarb | µg/L | 0.02 |
| EPA 508 | Toxaphene | µg/L | 0.4 |
| EPA 508 | Trifluralin | µg/L | 0.05 |
| Organic Phosphorus Pesticides | | | |
| EPA 508 | Azinphos methyl (Guthion) | µg/L | 0.05 |
| EPA 508 | Benfluralin | µg/L | 0.01 |
| EPA 508 | Bromacil | µg/L | 1 |
| EPA 508 | Carbophenothion (Trithion) | µg/L | 0.02 |
| EPA 508 | Chlorpyrifos | µg/L | 0.01 |
| EPA 508 | Cyanazine | µg/L | 0.3 |
| EPA 508 | Demeton (Demeton O + Demeton S) | µg/L | 0.02 |
| EPA 508 | Diazinon | µg/L | 0.01 |
| EPA 508 | Dimethoate | µg/L | 0.01 |
| EPA 508 | Disulfoton | µg/L | 0.01 |
| EPA 508 | Ethion | µg/L | 0.01 |
| EPA 508 | Malathion | µg/L | 0.01 |
| EPA 508 | Methidathion | µg/L | 0.02 |
| EPA 508 | Mevinphos | µg/L | 0.01 |
| EPA 508 | Naled | µg/L | 0.02 |
| EPA 508 | Napropamide | µg/L | 5 |
| EPA 508 | Norflurazon | µg/L | 5 |

| | | | |
|--|--|------|------|
| EPA 508 | Parathion (Ethyl) | µg/L | 0.01 |
| EPA 508 | Parathion, Methyl | µg/L | 0.01 |
| EPA 508 | Pendimethalin | µg/L | 5 |
| EPA 508 | Phorate | µg/L | 0.01 |
| EPA 508 | Phosalone | µg/L | 0.02 |
| EPA 508 | Phosmet | µg/L | 0.02 |
| EPA 508 | Profenofos | µg/L | 0.01 |
| EPA 508 | Prometryn | µg/L | 0.05 |
| EPA 508 | Propetamphos | µg/L | 0.1 |
| EPA 508 | Ronnel | µg/L | 0.01 |
| EPA 508 | s,s,s-Tributyl Phosphorotrithioate (DEF) | µg/L | 0.01 |
| EPA 508 | Trifluralin | µg/L | 0.01 |
| | | | |
| Volatile Organics (Purgeable) | | | |
| EPA 502.2 | 1,1,1,2-Tetrachloroethane | µg/L | 0.5 |
| EPA 502.2 | 1,1,1-Trichloroethane | µg/L | 0.5 |
| EPA 502.2 | 1,1,2,2-Tetrachloroethane | µg/L | 0.5 |
| EPA 502.2 | 1,1,2-Trichloroethane | µg/L | 0.5 |
| EPA 502.2 | 1,1-Dichloroethane | µg/L | 0.5 |
| EPA 502.2 | 1,1-Dichloroethene | µg/L | 0.5 |
| EPA 502.2 | 1,1-Dichloropropene | µg/L | 0.5 |
| EPA 502.2 | 1,2,3-Trichlorobenzene | µg/L | 0.5 |
| EPA 502.2 | 1,2,3-Trichloropropane | µg/L | 0.5 |
| EPA 502.2 | 1,2,4-Trichlorobenzene | µg/L | 0.5 |
| EPA 502.2 | 1,2,4-Trimethylbenzene | µg/L | 0.5 |
| EPA 502.2 | 1,2-Dibromo-3-chloropropane (DBCP) | µg/L | 0.5 |
| EPA 502.2 | 1,2-Dibromoethane | µg/L | 0.5 |
| EPA 502.2 | 1,2-Dichlorobenzene | µg/L | 0.5 |
| EPA 502.2 | 1,2-Dichloroethane | µg/L | 0.5 |
| | | | |
| Volatile Organics (Purgeable), continued | | | |
| EPA 502.2 | 1,2-Dichloropropane | µg/L | 0.5 |
| EPA 502.2 | 1,3,5-Trimethylbenzene | µg/L | 0.5 |
| EPA 502.2 | 1,3-Dichlorobenzene | µg/L | 0.5 |
| EPA 502.2 | 1,3-Dichloropropane | µg/L | 0.5 |
| EPA 502.2 | 1,4-Dichlorobenzene | µg/L | 0.5 |
| EPA 502.2 | 2,2-Dichloropropane | µg/L | 0.5 |

| | | | |
|-----------|--------------------------------|------|-----|
| EPA 502.2 | 2-Chlorotoluene | µg/L | 0.5 |
| EPA 502.2 | 4-Chlorotoluene | µg/L | 0.5 |
| EPA 502.2 | 4-Isopropyltoluene | µg/L | 0.5 |
| EPA 502.2 | Benzene | µg/L | 0.5 |
| EPA 502.2 | Bromobenzene | µg/L | 0.5 |
| EPA 502.2 | Bromochloromethane | µg/L | 0.5 |
| EPA 502.2 | Bromodichloromethane | µg/L | 0.5 |
| EPA 502.2 | Bromoform | µg/L | 0.5 |
| EPA 502.2 | Bromomethane | µg/L | 0.5 |
| EPA 502.2 | Carbon tetrachloride | µg/L | 0.5 |
| EPA 502.2 | Chlorobenzene | µg/L | 0.5 |
| EPA 502.2 | Chloroethane | µg/L | 0.5 |
| EPA 502.2 | Chloroform | µg/L | 0.5 |
| EPA 502.2 | Chloromethane | µg/L | 0.5 |
| EPA 502.2 | cis-1,2-Dichloroethene | µg/L | 0.5 |
| EPA 502.2 | cis-1,3-Dichloropropene | µg/L | 0.5 |
| EPA 502.2 | Dibromochloromethane | µg/L | 0.5 |
| EPA 502.2 | Dibromomethane | µg/L | 0.5 |
| EPA 502.2 | Dichlorodifluoromethane | µg/L | 0.5 |
| EPA 502.2 | Ethyl benzene | µg/L | 0.5 |
| EPA 502.2 | Fluorobenzene | µg/L | 0.5 |
| EPA 502.2 | Hexachlorobutadiene | µg/L | 0.5 |
| EPA 502.2 | Isopropylbenzene | µg/L | 0.5 |
| EPA 502.2 | m + p Xylene | µg/L | 0.5 |
| EPA 8260 | Methyl tert-butyl ether (MTBE) | µg/L | 0.5 |
| EPA 502.2 | Methylene chloride | µg/L | 0.5 |
| EPA 502.2 | n-Butylbenzene | µg/L | 0.5 |
| EPA 502.2 | n-Propylbenzene | µg/L | 0.5 |
| EPA 502.2 | Naphthalene | µg/L | 0.5 |
| EPA 502.2 | o-Xylene | µg/L | 0.5 |
| EPA 502.2 | sec-Butylbenzene | µg/L | 0.5 |
| EPA 502.2 | Styrene | µg/L | 0.5 |
| EPA 502.2 | tert-Butylbenzene | µg/L | 0.5 |
| EPA 502.2 | Tetrachloroethene | µg/L | 0.5 |
| EPA 502.2 | Toluene | µg/L | 0.5 |
| EPA 502.2 | trans-1,2-Dichloroethene | µg/L | 0.5 |
| EPA 502.2 | trans-1,3-Dichloropropene | µg/L | 0.5 |
| EPA 502.2 | Trichloroethene | µg/L | 0.5 |
| EPA 502.2 | Trichlorofluoromethane | µg/L | 0.5 |

| | | | |
|--|---|------|-----|
| EPA 502.2 | Vinyl chloride | µg/L | 0.5 |
| | | | |
| <u>Chlorinated Phenoxy Acid Herbicides</u> | | | |
| EPA 515.1 | 2,4,5-T | µg/L | 0.1 |
| EPA 515.1 | 2,4,5-TP (Silvex) | µg/L | 0.1 |
| EPA 515.1 | 2,4-D | µg/L | 0.1 |
| EPA 515.1 | 2,4-DB | µg/L | 0.1 |
| EPA 515.1 | 2,4-Dichlorophenylacetic acid (DCAA) | µg/L | 0.1 |
| EPA 515.1 | Dacthal (DCPA) | µg/L | 0.1 |
| EPA 515.1 | Dicamba | µg/L | 0.1 |
| EPA 515.1 | Dichlorprop | µg/L | 0.1 |
| EPA 515.1 | Dinoseb (DNPB) | µg/L | 0.1 |
| EPA 515.1 | MCPA | µg/L | 0.1 |
| EPA 515.1 | MCPP | µg/L | 0.1 |
| EPA 515.1 | Pentachlorophenol (PCP) | µg/L | 0.1 |
| EPA 515.1 | Picloram | µg/L | 0.1 |
| EPA 515.1 | Triclopyr | µg/L | 0.1 |
| | | | |
| <u>Glyphosate</u> | | | |
| EPA 547 | Aminomethylphosphonic Acid (AMPA) | µg/L | 100 |
| EPA 547 | Glyphosate | µg/L | 100 |
| | | | |
| <u>Carbamate Pesticides</u> | | | |
| EPA 531.1 | 3-Hydroxycarbofuran | µg/L | 2 |
| EPA 531.1 | Aldicarb | µg/L | 2 |
| EPA 531.1 | Aldicarb sulfone | µg/L | 2 |
| EPA 531.1 | Aldicarb sulfoxide | µg/L | 2 |
| EPA 531.1 | Carbaryl | µg/L | 2 |
| EPA 531.1 | Carbofuran | µg/L | 2 |
| EPA 531.1 | Formetanate hydrochloride | µg/L | 100 |
| EPA 531.1 | Methiocarb | µg/L | 4 |
| EPA 531.1 | Methomyl | µg/L | 2 |
| EPA 531.1 | Oxamyl | µg/L | 2 |
| | | | |
| <u>Pyrethrins</u> | will be analyzed if a suitable methods are identified becomes available through discussions with the Department of Pesticide Regulation | | |

Task 32—Hyporheic Monitoring

Hyporheic zones along the Feather River will be monitored by collecting water level and monthly water quality data from ponds in the Oroville Wildlife Area. These data will be compared to river stage level and water quality data collected from the Feather River downstream from the Fish Barrier Dam as part of Study Plan SP-W1. Stage recorders will be used to measure and record water level changes at 15-minute intervals in ponds and the river. Existing wells and piezometers, which may lie between the ponds and river, may also be used for data collection. Parameters analyzed from the ponds would include those found to be present in the Feather River in Study Plan SP-W1. Pond locations and dimensions, stage recorder locations, well and/or piezometer locations, and water level data will be entered into a GIS database.

Both the water level and water quality data sets will indicate the degree of hydraulic connectivity between the river and the ponds. Fluctuations in pond water levels will be compared to different stages of the Feather River to determine if pond water level and river stage levels are temporally related. Pond water quality will be compared to river water quality to determine if constituents found in the river water are also in the pond water.

Additional shallow monitoring wells or piezometers may be constructed between the river and ponds to aid in river stage-pond level and source water determinations. If physical and chemical data indicate concern for groundwater contamination, then effects on benthic macroinvertebrates in the hyporheic zone may need to be analyzed in a subsequent phase of the study. The need for subsequent phases will be discussed with the Environmental Work Group after analyses and presentation of data from this study. The hyporheic zone will be characterized using stage recorders and analyses of water samples. Stage recorders will be installed along the river and selected Oroville Wildlife Area ponds to evaluate the effects of river level changes on pond levels. Water samples collected for chemical analyses from the ponds will be compared to river water chemical analyses collected in Study #SP-W1 to evaluate the relationship between river water quality and that in the ponds. Additional shallow monitoring wells may be constructed between the river and ponds to aid in river stage-pond level and source water determinations. If physical and chemical data indicate concern for groundwater contamination, then effects on benthic macroinvertebrates in the hyporheic zone may need to be analyzed in a subsequent phase of the study.

Task 3. Progress Report

Progress reports will be prepared at the conclusion of the first and subsequent phases of the study. Interim output products will be identified through coordination with other work groups to meet their data needs.

Task 4. Final Report

A final report will be prepared following completion of the study.

Task 4—Interim Report

Task 5—Final Report

6.0 Results and Products/Deliverables

Results

Groundwater level data compiled as part of Task 1, Phase 1, as well as Thermalito Forebay and Afterbay water level data compiled for Study Plan SP-W-1, will be used to generate potentiometric maps to illustrate the physical influence or lack of influence that the Thermalito project features have on groundwater. Groundwater analytical data compiled under Phase 1 and, if needed, under Task 1, Phase 2 will be compared with surface water quality data collected from the Thermalito project features under Study Plan SP-W1. Specifically, the ionic composition and physical characteristics of the groundwater will be compared to that of the surface waters of the Thermalito Forebay and Afterbay. This data will be displayed using Stiff diagrams or similar graphics. Waters showing similar or identical ionic compositions and similar or identical physical traits indicate the waters may be of the same origin. Water quality data from the Thermalito Forebay and Afterbay will be reviewed to determine if there are any deleterious substances in the water. Groundwater quality data compiled under Task 1 and, if needed, Task 2, will be reviewed to determine if the same substances were detected.

A brief report will be prepared after Task 1, Phase 1 is complete. The report will present an appendix of all wells used to assess the potential affects of the Thermalito Forebay and Afterbay on groundwater levels and groundwater quality. The appendix will be generated from the compiled GIS database; it will have the well name, location, elevation, depth, use, and other pertinent data. Non-confidential information from well logs and well constructions, if available, will be presented in a second appendix. A third appendix will present the groundwater level and groundwater quality data for those wells used to assess potential impacts from the Thermalito Forebay and Afterbay. A fourth appendix will present pertinent data obtained from Study Plan SP-W1 and used for this study. The report will present potentiometric maps generated from the GIS database, which will illustrate groundwater levels in the vicinity of the Thermalito Forebay and Afterbay. It will also present tables, graphs and figures which detail and compare the general mineral chemistry and quality of the groundwater to the general mineral chemistry and quality of the Thermalito surface waters obtained from Study Plan SP-W1. The report will include an interpretation of potential groundwater influences of the Thermalito project features based on the presented data. The report will assess the need to construct additional wells or piezometers and conduct additional groundwater sampling and analyses, as detailed in Task 1, Phase 2.

If Phase 2 is conducted, a second report will be prepared following the conclusion of that phase in which all data are presented in appendices, and the potential affects of the Thermalito Forebay and Afterbay on groundwater levels and quality are assessed. The report will contain similar tables, graphs, figures, and maps as the report prepared for Phase 1, and will include evaluation of the groundwater influences of Thermalito project waters on groundwater levels and quality.

A third report will be prepared to present and discuss hyporheic data obtained under Task 2. The report will have maps generated from the GIS database which illustrate the locations of select ponds in the Oroville Wildlife Area relative to the Feather River. Cross sections will also be generated to illustrate recorded temporal changes in pond water levels and river stage levels. These illustrations will demonstrate the physical existence, or lack of existence, of hyporheic connections between the ponds and the Feather River. Pond

water quality collected as part of Task 2, in conjunction with Feather River water quality data collected as part of Study Plan SP-W1, will be used to determine if the pond water quality and river water quality have similar chemical signatures, possibly indicating more subtle hyporheic connections. The report will present tables, graphs, and figures which detail and compare pond water general mineral chemistry and quality to the river water general mineral chemistry and quality. Other water quality analytical data will be reviewed to determine if there are any deleterious substances in the pond water that are also present in the river water. The report will interpret the presented data, providing a qualitative estimated extent to which the Feather River is hydraulically connected to ponds in the Oroville Wildlife Area, and it will assess the need to construct additional wells or piezometers. The report will include an appendix of all water level and analytical data used for this task.

~~Data obtained from this study will be compared to applicable numerical and narrative water quality objectives and goals. Surface water quality data from Study #SP-W1 will be compared to groundwater quality data from this study to evaluate the degree of connectivity between surface and groundwater, and effects to groundwater quality in relation to natural groundwater quality. Water quality data will be presented in tables and graphs showing relationships between surface water and groundwater and applicable criteria. Groundwater elevation data will be evaluated to determine the influence of project water bodies on recharge to groundwater, and potential adverse effects from project recharge. Groundwater level data will be presented on contour maps.~~

~~Water quality data from the ponds and river will also be presented in tables and graphs to illustrate their relationship. Water levels in the river and ponds will be presented in graphs to illustrate their hydraulic connectivity, water quality relationship, and time (lag) relationship for changes in elevation.~~

Compliance with groundwater quality objectives will be used to evaluate project effects on designated beneficial uses for groundwater in the project area as defined in the Basin Plan. Information developed from this study will be presented to the SWRCB for review and determination of conditions to be included in the water quality certification to comply with Section 401 of the Federal Clean Water Act. The certification requires a determination by the SWRCB that the project complies with appropriate requirements of the CVRWQCB Basin Plan. The water quality certification is needed ~~to file with the application~~ for license renewal ~~with by FERC.~~

7.0 Coordination and Implementation Strategy

Coordination with Other Resource Areas/Studies

This study will provide information for determination of project compliance with water quality standards and other appropriate requirements in the application for water quality certification.

This study will be coordinated with ~~Study #Study Plan SP-W1 (Project Effects on Water Quality Designated Beneficial Uses for Surface Waters) Issue Statements W1, W2, and W3~~, and use water quality data for the Feather River from that study for comparison with groundwater quality data. The study will also be coordinated with ~~Study #Study Plan SP-W2 (Contaminant Accumulation in Fish, Sediments, and the Aquatic Food Chain Issue Statement W6)~~ for determination of hyporheic effects on contaminant accumulation in

aquatic organisms in the Oroville Wildlife Area ponds. Water quality information from the ponds developed by this study will be used in the terrestrial and fisheries studies to evaluate any effects to terrestrial and fish species.

Issues

This study plan provides information for evaluation of Issue Statement W17 (Effects of reservoirs and Feather River downstream of Oroville Dam on groundwater quality and quantity (e.g. hyporheic zone interaction). This study directly or indirectly addresses the following specific issues:

Direct (global changes to the terms ‘direct’ and ‘indirect’)

- W17—Effects of reservoirs and Feather River downstream of Oroville Dam on groundwater quality and quantity (e.g. hyporheic zone interaction). Issue Addressed: WE55 WE 55. Effects of reservoirs and Feather River downstream of Oroville Dam on groundwater quality and quantity (e.g. hyporheic zone interaction).

Indirect

There are no indirect issues associated with this study plan.

8.0 Study Schedule

Task 1 of the study will begin in the spring of 2002. The initial phase of this task will consist of compiling a catalogue of wells in the field areas around the Thermalito Forebay and Afterbay and determining which wells will be useful for determining potential impacts to groundwater from the Thermalito project features. The groundwater model will also be reviewed for relevant information. A review of existing groundwater quality data for these wells will be performed, including a review of data currently being collected from select wells which are part of the DWR Northern District groundwater level and groundwater quality monitoring program. Data from Study Plan SP-W1 will also need to be acquired at this stage. A brief report as summarized in Section 6.0 of this study plan will be prepared based on the compiled data and is anticipated to be completed by late 2002.

Task 1, Phase 2 of the study will be conducted depending on the findings of the Task 1, Phase 1 summary report. If Phase 2 is needed, groundwater level measurement and water quality data collection would begin in the spring of 2003, and may continue through the fall of 2004. A report would be completed in 2004 following data collection activities.

Data collection for Task 2 will begin in the spring of 2002 and conclude at the end of spring in 2004. Pond water level measurements and collection of pond water samples for water quality analysis will be coordinated with river water data collection conducted as part of Study Plan SP-W1. A brief report as summarize in Section 6.0 of this study plan will be prepared based on the collected data. This report is anticipated to be completed by mid 2004.

Information developed in this study will be presented quarterly to the Environmental Work Group and Task Force for review to evaluate the adequacy and progress of the study, and to provide information needed by the other environmental work groups. The study will begin in early 2002. The initial stages of the study will focus on obtaining existing information from groundwater monitoring in the area, and identifying suitable wells for monitoring. Groundwater monitoring for the study would begin during the spring of 2002 and continue for two monitoring seasons. Groundwater level monitoring would occur during the spring and fall, while water quality monitoring would be conducted during the summer. Subsequently, additional water quality monitoring may be warranted for parameters that exceed goals or criteria. Information developed in this study will be presented quarterly to the Environmental Workgroup and Task Force for review to evaluate the adequacy and progress of the study, and to provide information needed by the other environmental work groups. A progress report will be prepared following completion of analysis of data from the first season of monitoring. A draft final report discussing results, implications for the project, and recommendations will be prepared at the end of the second season of monitoring.

9.0 References

CVRWQCB 1998. The Water Quality Control Plan (Basin Plan) for the California Regional Water Quality Control Board, Central Valley Region, Fourth edition. The Sacramento River Basin and the San Joaquin River Basin. CVRWQCB, Sacramento http://www.swrcb.ca.gov/rwqcb5/available_documents/index.html

SP-W9 Project Effects on Natural Protective Processes

March ~~1927~~, 2002

1.0 Introduction/Background

The natural protective processes of a riverine system are a complex and, in many cases, overlapping array of interactions of the river's waters with the biological and physical structure around it, including the riparian zone (and adjacent wetlands) and in-stream riffles. To adequately describe the potential project effects on these complex processes, an ecosystem level approach is necessary. Therefore, while developing new studies, this study cooperates with and incorporates data from related geology, terrestrial, and water quality studies. This study will evaluate the potential effects of the project on the functions of the riparian and wetlands resources along the Feather River and the riffle-pool complex within the Feather River.

2.0 Study Objective

The objective of the study is to determine the effect of the project on natural protective processes that ~~impact~~ water quality of those areas adjacent to and under the influence of project waters. ~~The~~ is goal study will provide information to ~~would be used to identify potential protection, mitigation and enhancement measures eliminate, reduce, or control project-related effects to maintain and enhance the viability and sustainability of the ecosystems along the Feather River.~~

3.0 Relationship to Relicensing/Need for the Study

The study will be used to demonstrate the post-project effectiveness of natural protective processes on biological, physical, and chemical integrity of waters within the project area. The United States Fish and Wildlife Service (USFWS) and the National Marine Fisheries Service (NMFS) ~~requires~~ this information to determine project effects on the habitat of listed species, including salmon and steelhead.

4.0 Study Area

The Study Area includes waters and lands within the project boundary, and along the Feather River within the levee system, if present, or the extent of the riparian/wetland vegetation, whichever is greater, downstream to the Sacramento River.

Study plans approved by the Environmental Work Group define the limits of the study area. If initial study results indicate that the study area should be expanded or contracted, the Environmental Work Group will discuss the basis for change and revise the study area as appropriate.

5.0 General Approach

This study will evaluate project effects to natural water quality protective processes in riparian and wetland areas as Task 1 and riffle areas as Task 2. If initial study results indicate that the methods and tasks should be modified, the Environmental Work Group will discuss the basis for change and revise the study plans as appropriate.

Task 1—Riparian and Wetland Areas

The riparian areas, which include adjacent wetlands, of rivers and lakes perform a variety of natural protective processes, primarily through the filtration and uptake of nutrients, minerals, and other water-borne constituents, by vegetation. These areas are fed by the adjacent river during higher stages, and subsequently recharge the river during lower stages. The quality of this recharge, therefore, affects the quality of the water in the river. Riparian areas also shade the river's waters in many areas to reduce or maintain cooler water temperatures. Sediments, especially fine material, are deposited in these areas. These areas also tend to have the highest densities and diversity of wildlife and fisheries, which depend on these areas as rearing grounds, cover, food supply, and for other biological functions.

Literature will be reviewed to document the known effects of riparian areas on water quality, and will be used to help evaluate the relation between changes in riparian areas and water quality. Information about changes in riparian areas from ongoing or potential changes in project operations will be obtained from Under Study Plan SP-T3/5, maps of the current and historical riparian and wetland areas will be generated and digitized into GIS. The historical riparian and wetland maps will be compared to the current maps to assess the amount and type of change that may have occurred as a result of project-related activities.

Under Study Plan SPW5, water quality sampling, including nutrients and minerals, will be conducted and basic water quality parameters, including temperature, conductivity, dissolved oxygen, and pH, will be measured in the adjacent wetland areas, including marshes and ponds, for comparison with results from measurements in the Feather River taken in information will be obtained from Study Plan SP-W1 for the Feather River and SP-W5 for ponds in the Oroville Wildlife Area.— Information from these sources will be used to evaluate potential effects to water quality from changes or potential changes in the riparian vegetative communities. If additional information is needed for this determination, including site specific data collection and analyses, a subsequent phase will be proposed to the Environmental Work Group for concurrence.

In this study, shallow groundwater quality sampling, as well as flow and levels measurements, will be measured conducted in shallow uncased 30-foot wells along transects through representative vegetated and depauperate the riparian areas to demonstrate how riparian areas affect water quality. Changes in nutrients and other environmental variables will be tracked through the riparian areas along the transects, to the extent possible, and contours delineating the change of these variables from river waters to wetland waters will be mapped through GIS. In addition, the hyporheos (i.e., interstitial macroinvertebrates) will be used as biological indicators of the extent of river water movement underground through the riparian zone. Water quality attenuation and connectivity will then be modeled using ArcView 3D Analyst to demonstrate

~~graphically the effects of the project on water quality due to potential continuing changes to riparian areas. Literature will be reviewed to document the known effects of riparian areas on water quality, and will be used as a baseline to help evaluate determine the relation between the loss of changes in riparian areas and the reduction of the beneficial effects of riparian areas to water quality.~~

Task 2—Riffle Areas

Riffles are the primary re-oxygenators of waterways, while also serving as spawning grounds and cover for various fishes, including salmonids, and habitat for macroinvertebrates. The oxygenation process in riffles also plays a significant role in the reduction of nutrient and mineral loading in a riverine system. Riffles are sensitive to water level fluctuations and loss of gravel recruitment. Without sufficient flow, movement of cold water, oxygen, and nutrients into and through riffles and removal of biological waste products are ~~depletedreduced~~. ~~According to the HP, salmonid egg survival to emergence is around five to fifteen percent. This low level of survival may be due, in part, to the lack of oxygenation or removal of metabolic waste products.~~

Published literature will be reviewed for known effects of riffle areas on protection and improvement of water quality, factors that decrease those natural protective processes, and water quality conditions needed for successful salmonid egg and alevin survival. Under Study Plans ~~SP-G1 and SP-G2~~, pools, riffles, and runs will be mapped ~~using recent digital ortho-rectified quarter quad aerial photographs and compared to. Riffle areas from~~ historical and current maps ~~will be compared~~ to assess the extent of change. Study plan SP-G2 will also analyze sediment composition of riffles, which affect the rate of water flow through the interstices. Several of the mapped riffles will be included in water quality Study Plan SP-W1, which will measure dissolved oxygen, temperature, conductivity, pH, and other parameters in the water column, and analyze aquatic macroinvertebrate communities. This study plan will measure dDissolved oxygen, water temperature, conductivity, and pH ~~will be measured~~ within ~~and above~~ the riffle gravels with calibrated meters and probes at ~~all of the mapped riffles monitored for~~ water quality ~~sampling sites~~ in Study Plan SP-W1. Ammonia, a product of the breakdown of organic matter that may affect salmon egg and alevin survival, will be sampled from the interstitial waters through aspiration. ~~Sampling and evaluation of the measured riffles will occur in late spring, mid summer, and early fall. After the late fall sampling, sampling will be performed monthly to the period when alevins are no longer present, based on information from fisheries studies.~~Study Plan SP-F10 indicates that incubation in gravels of eggs and alevins of chinook salmon and steelhead trout occurs from mid August through March and December through June, respectively. Therefore, interstitial water quality will be measured throughout the year at monthly intervals, and more frequently (i.e., bimonthlytwice monthly) if water quality conditions are identified that may affect egg or alevin survival. Riffle areas cleansed by spawning salmonids and areas uncleansed will be sampled. This study will use this data to determine the effects of the project on the natural protective process of riffles in ~~loss of~~ oxygenation, waste product removal, and other protective processes in the Feather River ~~due to the project~~.

Task 3. Progress Report

A progress report will be prepared at the conclusion of the first year of study. Interim output products will be identified through coordination with other workgroups to meet their data needs.

Task 4. Final Report

A final report will be prepared following completion of the study.

6.0 Results and Products/Deliverables

Results

~~These data~~ Information from this study will be ~~evaluated~~ analyzed to determine if there is any ~~net loss of effect from the project to~~ the natural protective processes that ~~maintain and improve~~ impact water quality ~~and their functionality~~ in the Feather River system. The effects of the project to natural water quality protective processes in riparian areas will be assessed through ~~GIS modeling to determine the amount of change from pre-project to post-project quality and quantity.~~ The effects of the riparian areas on water quality will be ~~assessed, through this comparison, the~~ a literature review of the affects of riparian areas on water quality and evaluation of changes in riparian quality and extent. Additional sampling may also be conducted for site specific data, ~~and current sampling to determine if there is a project-related effect on water quality in the Feather River.~~

~~The~~ Results of ~~from~~ the literature review, riffle-pool sediment assessment from Study Plans ~~SPG1 and SPG2~~ SP-G2, and the macroinvertebrate and water column water quality assessments from Study Plan SP-W1 will be used with additional information collected from this study to evaluate effects to natural water quality protective processes of riffles. ~~analyzed using principal component analysis ordination with a cluster analysis among water quality variables, sediment grain size, and macroinvertebrate assemblage structure.~~ Species richness and diversity will be calculated from the macroinvertebrate data from SP-W1 for an indication of water quality conditions and health of the invertebrate community. ~~and compared to the w~~ Water quality variables in the water column will be compared to those present in riffle gravels to evaluate the cleansing ability of the riffles. Sediment data will be used with available literature to evaluate effects to flow of water through riffle gravels and removal of metabolic waste products ~~collected in this study to demonstrate the effect of environmental variables on macroinvertebrate community structure in riffles.~~ These analyses will be used to evaluate potential project effects on the natural protective processes of water quality in riffle areas in the Feather River.

Products/Deliverables

The following products will be developed for this study:

- Progress Report
- Final Report

7.0 Coordination and Implementation Strategy

Coordination with Other Resource Areas/Studies

Mapping of riparian and wetland areas will be performed under Study Plans SP_T3/~~to SPT5~~, while riparian habitat quality will be obtained from Study Plan SP_T1. Physical, chemical, and biological components of water quality ~~that could affect the natural protective processes~~ from the water column will be obtained by Study Plan SP_W1. ~~Groundwater information will be gathered under Study Plan SPW5. Data concerning the~~ Riffles-pool complexes will be mapped and sediments sampled in ~~obtained from~~ Study Plans ~~SPG1 and SP~~ G2. If any issues arise during the duration of this study or other studies that are directly related to the natural protective processes for water quality, an amended ~~new~~ study plan will be proposed in coordination with the Environmental Working Group and Task Force.

~~Issues, Concerns, Comments Tracking, and/or Regulatory Compliance Requirements~~

This study plan provides the information for evaluation of Issue Statement W18 (Effect of existing and future project facilities and operations on natural protective processes (e.g., marshes)), and will provide information for determination of project compliance with water quality standards and other appropriate requirements in the application for water quality certification. This study directly or indirectly addresses the following specific issues:

Direct ~~This study will address the following Issue Statements and associated specific Issues:~~

- WE9. Encourage natural protective processes

Indirect

There are no indirect issues addressed by this study.

~~G1— Effects of existing and future project operations on natural geomorphic processes. These include physical attributes and functions, (e.g., channel morphology, channel stability, sediment transport and deposition, large woody debris recruitment, habitat diversity) and biological resources (e.g., aquatic macroinvertebrates, riparian vegetation) in the low flow section and in the River downstream of Thermalito Afterbay under wet and dry year criteria. (Issues addressed: 3, 4, 5, 6, 7, 9, 10, 12, 19, 23, 24, and 25)~~

~~T3— Effects of project operations on floodplains and project water fluctuation zones, including soil stability, wildlife habitat and natural flood control functions, revegetation and restoration opportunities (e.g., red willow planting). (Issues addressed: 6, 52, 57, and 62)~~

~~T5— Project effects on riparian resources and protection and management of riparian habitat and wetlands (including vernal pools). (Issues addressed: 23, 24, 34, 35, 37, 39, 49, 53, and 62)~~

~~W3— Effects of the continued operation of the project on the physical, chemical and biological quality of the Feather River, affected tributaries and downstream waters. (Issues addressed: 3, 10 24, 25, 30, 31, 32, 33, 40, 46, 48, and 50)~~

W8—Effect of project-related land management activities (including waste disposal and upland pesticide use) on water quality, slope stability, erosion, sedimentation, channel stability, riparian habitat, fish habitat, and other beneficial uses. (Issues addressed: 8, 11, 12, 13, 14, 15, 34, 41, and 46)

8.0 Study Schedule

The riffle pool study will commence in early 2002, in conjunction with Study Plans SPG1 and SPG2. ~~The literature review to determine the role of riparian and wetland areas in natural protective processes evaluation will commence in early 2002 and should be completed by fall of 2002, and may take one to two years.~~ Subsequently, ~~information about changes in riparian areas from Study Plan SP-T3/5 and water quality data from Study Plans SP-W1 and SP-W5 will be used to evaluate project effects to natural water quality protective processes of riparian and wetland areas along the Feather River. Sufficient information from these study plans to begin this evaluation is not expected until the spring of 2003. The initial evaluation should be completed by the summer of 2003. If initial evaluation indicates the need for site specific data collection, an amended study plan will be presented to the Environmental Work Group for concurrence. A final report is expected to be completed by mid 2004. years of data collection and analyses on all of the issues may be necessary to focus on specific parameters that appear to be impaired.~~ The literature review to evaluate the effects of riffles to natural water quality protective processes will begin in the spring of 2002. Water quality data collection will commence in the spring of 2002, in conjunction with data collection for Study Plan SP-W1. ~~Interim results will be provided to the water quality, terrestrial, and fisheries work plans, as necessary.~~ A Progress Report will be submitted at the end of the first year, and at the end of all subsequent years ~~if the study is extended.~~ A Final Report will be submitted at the end of ~~two years~~ the study for the relicensing process. ~~Interim results will be provided to the water quality, terrestrial, and fisheries work plans, as necessary.~~

SP-T6 Interagency Wildlife Management Coordination and Wildlife Management Plan Development

March 27, 2002

1.0 Introduction/Background

Several land management agencies actively manage wildlife resources within the project boundary including Plumas National Forest, Bureau of Land Management, California Department of Fish and Game, California Department of Parks and Recreation, and California Department of Water Resources. Each of these land management agencies has differing missions, policies, management direction, funding levels and priorities related to management of wildlife resources. Stakeholders have suggested that opportunities exist to improve interagency coordination, management, and planning related to wildlife resources.

2.0 Study Objective

- ~~• Identify opportunities to enhance interagency coordination, management, and planning related to wildlife resources within the project area.~~
- Develop a coordinated interagency terrestrial resource management plan for the project area, including the Oroville Wildlife Area.
- Identify funding needed to meet resource management goals
- Identify opportunities to enhance interagency coordination, management, and planning related to wildlife resources within the project area.
- ~~• Create a forum to discuss terrestrial resource relicensing studies and facilitate resolution of potentially conflicting land use and wildlife management issues over the term of the license (adaptive management).~~

3.0 Relationship to Relicensing /Need for the Study

There is concern that wildlife management of project lands may currently be undertaken in a piecemeal fashion by each individual land management agency. ~~Previous interagency wildlife management decisions may not have always proceeded in a coordinated manner, forcing regulatory agency intervention.~~ This study will identify opportunities to improve interagency coordination and communication on land use and wildlife management issues over the term of the license. The study is important to the development of a wildlife management plan that is required by FERC.

4.0 Study Area

Within the FERC Project boundary and other areas that affect wildlife use of Project lands. Study plans approved by the Environmental Work Group define the limits of the study area. If initial study results indicate that the study area should be expanded or contracted, the Environmental Work Group will discuss the basis for change and revise the study area as appropriate.

5.0 General Approach

If initial study results indicate that the methods and tasks should be modified, the Environmental Work Group will discuss the basis for change and revise the study plan as appropriate.

Task 1–

Collect and analyze each land management agencies' current mission, goals, objectives, management direction, policies and plans as they relate to wildlife management within the study area.

Task 2 –

Identify common elements in land management agencies' plans and policies as well as inconsistencies between agencies.

Task 3 –

~~At the task force level, discuss and resolve identified management inconsistencies.~~ In coordination with appropriate agencies, e Evaluate the adequacy of current levels of wildlife management and fish and wildlife related law enforcement ~~funding~~.

Task 4 –

~~At the task force level, identify~~ Identify methods for improving interagency communication and coordination on wildlife issues.

Task 5 -

Explore ~~funding needs and~~ needs and sources for wildlife management and law enforcement funding.

Task 6 –

~~At the task force level develop~~ Develop criteria for development of a coordinated Wildlife Management Plan for the project area.

Task 7 –

~~Complete~~ Review results of all relicensing studies related to wildlife resources.

Task 8–

Develop a Preliminary Wildlife Management Plan using the information and agreements developed under tasks 1-~~6~~7 as well as results from other relicensing studies.

Task ~~89~~—

Revise draft plan to include public and agency concerns and comments and results from settlement negotiations.

Task ~~9~~—10 -

Submit to FERC a Wildlife Management Plan.

6.0 Results and Products/Deliverables

Results

The product of this study will be a wildlife management plan for the lands within the project area that is consistent to the extent possible with wildlife management plans relevant to the study area. This plan will identify how interagency coordination ~~will~~ could occur in the future, guidelines for wildlife management, opportunities for interagency habitat improvements, evaluation of current wildlife management and law enforcement funding, relicensing protection, mitigation, and enhancement measures, and coordinated monitoring efforts. For example results of this study could recommend formation of an interagency task force to facilitate resolution of potentially conflicting land use and wildlife management issues over the term of the license (adaptive management).

7.0 Coordination and Implementation Strategy

Coordination with Other Resource Areas/Studies

This study will be conducted concurrently with other terrestrial resource studies. Products from this study are highly dependent on the participation of all land management agencies ~~in a special task force~~. The results of other terrestrial resource studies will be incorporated into the final product. This study will also be coordinated with SP-LU2, SP-LU3, and SP-R5. Evaluation of current and future fishing and hunting opportunities will be handled in the Recreation and Socioeconomics Work Group.

Issues, Concerns, Coordination Tracking, and/or Regulatory Compliance

This study will evaluate interagency wildlife management coordination, adequacy of management plans and activities and funding for wildlife management

This study will evaluate interagency wildlife management coordination, adequacy of management plans and activities, and funding ~~needs~~ for wildlife management.

Direct

- TE26—Are additional funds needed to augment the existing budget of the Oroville Wildlife Area? Presently available Fish and Game funds are being dedicated to managing people and not wildlife habitat.
- ~~32—DWR and DFG to work cooperatively to preserve hunting and fishing opportunities in the afterbay and borrow areas, and Lake Oroville. (transfer to Rec Group)~~
- TE49—Responsible management by resource agencies.
- ~~50—Effects of fluctuating water levels in afterbay on wildlife. This issue addressed elsewhere.~~
- TE54—Evaluation of funding adequacy for Oroville Wildlife Area.
- TE55—Evaluation of funding adequacy for law enforcement.
- ~~56—Adequacy of survey information to document the presence of state or federally listed plant or animal species that are potentially impacted by project. This issue addressed elsewhere.~~

8.0 Study Schedule

Tasks 1 and 2 completed by June 2002. Tasks 3, 4, and 5 completed by ~~end of December~~ September 2002. Task 6 completed by July 2004. Task 7 completed by ~~July~~ October 2004. Task 8 and 9 completed by December 2004. An interim report will be prepared in January 2003.

SP-T8 Project Effects on ~~Undesirable~~ Non-Native WildlifeMarch ~~1927~~, 2002**1.0 Introduction/Background**

The California Wildlife Habitat Relationships Program identifies ~~at least~~ 14 non-native vertebrate wildlife species as having potential to occur within the project area, including, including six birds, seven mammals, and one amphibian (Table 1).

**Table 1. List of Non-Native Vertebrate Wildlife Species
Potentially Found within the Project Area**

| Common Name | Scientific Name | Status |
|----------------------|-----------------------------|-------------|
| Bullfrog | <i>Rana catesbeiana</i> | DFG Harvest |
| House sparrow | <i>Passer domesticus</i> | |
| Bobwhite quail | <i>Colinus virginianus</i> | DFG Harvest |
| Ring-necked pheasant | <i>Phasianus colchicus</i> | DFG Harvest |
| Wild turkey | <i>Meleagris gallopavo</i> | DFG Harvest |
| Rock dove | <i>Columba livia</i> | |
| European starling | <i>Sturnus vulgaris</i> | |
| Virginia opossum | <i>Didelphis virginiana</i> | DFG Harvest |
| Black rat | <i>Rattus rattus</i> | |
| Norway rat | <i>Rattus norvegicus</i> | |
| House mouse | <i>Mus musculus</i> | |
| Muskrat | <i>Ondatra zibethicus</i> | DFG Harvest |
| Red fox | <i>Vulpes vulpes</i> | |
| Feral pig | <i>Sus scrofa</i> | DFG Harvest |

Several of these species were introduced by the California Department of Fish and Game as harvest species or are currently managed as harvest species (Table 1). All of these ~~harvest~~ species compete with, displace, or prey upon native wildlife to a certain extent. ~~However, due to their management status these species are not perceived as undesirable by the local public user groups or the California Department of Fish and Game. Therefore, these species will not be included in the analyses of the project effects on undesirable non-native wildlife.~~

~~Study efforts will focus the remaining seven non-native vertebrate wildlife species including house sparrow, rock dove, European starling, black rat, Norway rat, house mouse, and red fox. (include bullfrog, wild turkey, feral pig, cow birds) add to abstract as status to be completed~~

House sparrows were first introduced from Europe into the eastern United States around 1850 and rapidly spread across the country arriving in California at San Francisco in the early 1870s (Ziener et. al 1990). Preferred habitats include urban and croplands (primarily grain crops). This species occurs throughout the

project area near human habitation or livestock with highest densities frequently - near outdoor restaurants, stables, and other human developments.

House sparrows are aggressive nesters and frequently displace native avian species by evicting nesting adults or destroying nests. This species primarily impacts secondary cavity nesting species including swallows, western bluebird, house wren, and house finch.

Rock doves or domestic pigeons were also introduced from Europe. This species was probably introduced into the United States prior to 1800 as a food source. Preferred habitats includes perennial and annual grasslands as well as croplands, pasture, and urban. Rock doves nest within sheltered locations in variety of human-related structures including bridges and buildings (Harrison 1978). This species may compete with native species for food resources including waste grains, seeds, and human food scraps. Rock doves are preyed upon by several native species including peregrine falcon and several species of carnivorous furbearers.

European starlings were introduced into the United States from Europe and are currently an abundant species within the project area and nearby agricultural habitats. Preferred habitats include urban, cropland, pasture, and orchard/vineyard. They feed on insects, grains, garbage, fruits, nuts and seeds. This species can form large wintering flocks capable of inflicting damage to crops. Starlings (like house sparrows) are aggressive competitors for cavity nest sites. They will use almost any cavity greater than 1.5 inches diameter in buildings, nest boxes or trees (Bent 1950). They successfully displace wrens, nuthatches, swallows, titmouse, bluebirds, kestrels, acorn woodpeckers and wood ducks (Small 1974, Kessel 1957, Troetschler 1976, and Grabill 1977).

Black rats were introduced from Europe in the early 1800s and are relatively common in urban areas in California's Central Valley. In Northern California this arboreal species also occurs in riparian habitat, and Himalayaberry thickets (Ingles 1965, Dutson 1973). The introduced Norway rat and muskrat are this species closest competitor. Black rats carry a variety of diseases, which can effect humans including bubonic plague, rabies, typhus, tularemia, and trichinosis (Zeiner et. al 1990).

Norway rats were introduced from Europe and occur within the valley portions of the project area. Norway rats occur in both urban, agricultural, and native plant communities including wetlands and riparian habitats. Highest densities occur in dumps and grain croplands. Norway rats are omnivorous and prey upon native birds, eggs, and small mammals in addition to fruits, seeds, and garbage. Hawks, owls, foxes, weasels and snakes prey upon Norway rats. Like black rats, this species carries a variety of diseases including salmonellosis, tularemia, leptospiral jaundice, Haverhill fever, and typhus fever (Godin 1977).

House mice were also introduced from Europe and are common in the project area near human habitation. This species is less common in native plant communities but does occur in grassland, forest, and shrub habitats near urban habitats. Native harvest mice and microtus (voles) dominate this introduced species. Most carnivorous furbearers as well as hawks, owl, voles, snakes and rats prey on house mice. Like the other introduced rodents, which have evolved in close association with humans, this species can carry and transmit viral and bacterial diseases to humans.

Two subspecies of red fox occur in California. Native red foxes are restricted to higher elevation with most sightings ranging from 3,900 feet to 11,900 feet elevation (Schempf and White 1977). The introduced subspecies generally occurs at elevation less than 3,000 feet elevation (Schempf and White 1977). Original introduction of the non-native subspecies was probably related to hound hunting or fur farming. Red foxes within the project area are the non-native subspecies and use annual grasslands, perennial grasslands, emergent wetland and cropland habitats. They feed primarily on small mammals but are believed to be an increasingly important predator of nesting waterfowl, shorebirds, and upland game birds as its range and density continue to expand within California's Central Valley (Zeiner et. al 1990). Non-native red fox appears to coexist with native canids including coyote, gray fox, and kit fox.

Bull frogs are native to the eastern United States, and were introduced to California early in early 1900s. Bull frogs are now common and wide spread throughout the low elevation marsh, riparian, and other wetland habitats. Adult bullfrogs are opportunistic feeders taking both aquatic and terrestrial prey, including native frogs, snakes, salamanders, toads, and turtles. Bullfrog populations have been linked with the decline of native species associated with emergent wetland habitats.

Bobwhite quail have been introduced to California for hunting. Bobwhite quail have been designated as a "harvest species" by the CDFG and hunted within the project boundary. The effect of bobwhite quail on native wildlife species has not been determined.

The ring-necked pheasant was introduced from Eurasia for sport hunting. The ring-neck pheasant has been designated as a "harvest species." Captive raised pheasants continue to be released throughout California by hunters, and hunt clubs. This ground nesting bird is common in grain fields and open grasslands. The effect of ring-neck pheasant populations on native wildlife species has not been determined.

Wild turkeys were introduced to California in 1877. The range of wild turkey populations continues to expand in hilly oak woodland habitat. Wild turkeys nest from March to August. Wild turkeys have been designated as a "harvest" species by the CDFG. Turkey hunting takes place at several locations within the project boundary, including the Oroville Wildlife Area. The effect of wild turkey populations on native wildlife species has not been determined.

The Virginia opossum is common to abundant in woodland and bush habitats throughout California. Opossums have been designated a "harvest species," and were introduced to California in 1910 from the American Southeast. Since 1910, the range of the opossum have expanded to include most of California from the crest of the Sierras to the Pacific Ocean. The effect of opossum populations on native wildlife species has not been determined.

The muskrat occurs in emergent wetland habitats and riparian habitats with herbaceous cover. Muskrats have been introduced to California for fur production, and are currently classified by CDFG as a "harvest species." Burrowing activities can result in extensive damage to levees and ditches. The effect of muskrat populations on native wildlife species has not been determined.

Feral pigs have been widely introduced throughout California by accident escape and introductions for sport hunting. This species has been classified as a "harvest species" by CDFG. Feral pigs have become year-round residents of oak woodland, grassland, riparian, and conifer habitats. Acorns are an important component of their diet, but foraging for bulbs, insects, roots, and other herbaceous material causes extensive damage. The effect of feral pig populations on native wildlife species has not been determined.

2.0 Study Objectives

Identify potential changes in project operations, land use, features, and management practices which could serve to reduce the potential impact of these ~~seven undesirable~~ non-native wildlife species on native species and their habitats.

3.0 Relationship to Relicensing/Need for the Study

Relicensing participants have identified project effects including land management, project facilities, and operation on ~~undesirable~~ non-native wildlife as a relicensing issue. Non-native wildlife species can adversely impact native wildlife (including State and federal special status species) through competition, predation, and disease. Further, several of the ~~undesirable~~ non-native species have evolved in close association with humans and carry or transmit disease to humans. NEPA requires assessment of public health impacts. Many of the currently developed recreation facilities contain features or activities that are attractive to these non-native ~~undesirable~~ species.

4.0 Study Area

Within the project boundary ~~and downstream within the Feather River floodplain to the Yuba River as well as areas outside the project area as appropriate~~. ~~Many~~ est of the ~~undesirable~~ non-native species identified in the Introduction have relatively small home ranges and prefer urban or agricultural habitats. Study plans approved by the Environmental Work Group define the limits of the study area. If initial study results indicate that the study area should be expanded or contracted, the Environmental Work Group will discuss the basis for change and revise the study area as appropriate.

5.0 General Approach

~~For the purpose of this evaluation DWR will assume that all seven undesirable non-native wildlife species are present in the project area and that some level of project related effects may occur.~~

If initial study results indicate that the methods and tasks should be modified, the Environmental Work Group will discuss the basis for change and revise the study plan as appropriate.

Task 1—Literature Review

Review scientific literature related to species biology, habitat requirements, and life history requirements of the ~~seven~~ fourteen selected ~~undesirable~~ non-native wildlife species.

Task 2—

Using the information reviewed and collected under Task 1, conduct an ~~desktop~~ evaluation which identifies general management guidelines within the study area which serve to limit the occurrence of these ~~seven~~ fourteen selected ~~undesirable~~ non-native wildlife species.

Identify potential management practices that could be incorporated into the Wildlife Management Plan if it is determined that a problem with these ~~undesirable~~ non-native wildlife species exists or could exist during the term of a new license.

Task 3 –

Provide a qualitative assessment Lake Oroville State Recreation Area on the population and distribution of the wildlife species identified in Table 1. This data will be collected in coordination with SP-T1, SP-T2, and SP-T9.

6.0 Results and Products/Deliverables

Study results in the form of general management guidelines will be identified so that they can be incorporated into the Wildlife Management Plan.

7.0 Coordination and Implementation Strategy

Coordination with Other Resource Areas/Studies

This study will be conducted concurrently with other terrestrial resource studies. Results from this study may be incorporated into other terrestrial resource studies including SP-T2 (Special Status Species) and SP-T7 (Noxious Plants). Study results will be incorporated into Wildlife Management Plan (SP-T6) for submittal to FERC.

Issues, Concerns, Comments Tracking, and/or Regulatory Compliance Requirements

The following Issue will be addressed:

This study will evaluate project effects on undesirable non-native wildlife species.

- Issue Statement: effects of existing and future operations of project on the introduction, distribution and management of undesirable non-native wildlife species.

8.0 Study Schedule

Task 1 literature review completed by August 2002. Task 2 ~~desktop~~ desktop-analyses completed by April 2004⁴³.

Task 3 qualitative evaluation assessments completed by March 2004.

9.0 References

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SP-T10 Effects of Project Features, Operations and Maintenance on Upland Plant Communities

March ~~19~~27, 2002

1.0 Introduction/Background

Current and future operations of the Oroville Facilities may impact upland plant communities, including rare or unique community types. These impacts can be from any project-related activity that alters, degrades, destroys, or enhances habitat features necessary to support that plant community type. Changes in land use, maintenance and operation activities, or recreational use of an area could potentially affect plant communities within the Study Area.

A qualitative assessment and analysis of project-related impacts on the plant communities can provide program managers and stakeholders the information necessary to identify those management options or project modifications which minimize project-related impacts.

2.0 Study Objective

The objective of this study is to identify direct and indirect impacts of project features (facilities, operations, maintenance, and recreation) on upland vegetation communities including rare or unique plant communities.

3.0 Relationship to Relicensing/Need for the Study

Relicensing participants have identified project-related facilities, operations, maintenance, and recreation facilities and associated activities as having a potential effect on upland plant communities. An evaluation of project effects on botanical resources is also required for California Environmental Quality Act/National Environmental Policy Act (CEQA/NEPA) compliance, and will be included in the Federal Energy Regulatory Commission (FERC) license application.

The information collected will be used to identify opportunities to minimize or mitigate project-related impacts to plant communities and to identify potential areas for enhancement through revegetation and restoration of a site (protection, mitigation, and enhancement measures).

4.0 Study Area

The Study Area includes all areas within the FERC project boundary and other areas potentially affected by project recreation facilities and use. An analysis of downstream Feather River riparian habitats will be analyzed under SP-T3/5. For ESA analyses and their associated plant communities, the study area is defined in SP-T2. Study plans approved by the Environmental Work Group define the limits of the study area. If

initial study results indicate that the study area should be expanded or contracted, the Environmental Work Group will discuss the basis for change and revise the study area as appropriate.

PRELIMINARY DRAFT

5.0 General Approach

If initial study results indicate that the methods and tasks should be modified, the Environmental Work Group will discuss the basis for change and revise the study plan as appropriate.

Task 1—Data Collection and Review

Collect and review information affecting plant communities in the study area. Data to be collected include vegetation communities mapping and analysis (SP-T4); noxious weed locations and dispersal and management options (SP-T7); state and federal special status species analysis (SP-T2); riparian and wetland issues (SP-T3/5); fuels management (SP-T11); pesticide use (SP-LU2); pesticides in water samples (SP-W2); and soil types and topography information (SP-G1/G2). Obtain and review current and future project-related facilities data from the Recreation Work Group (SP-R5, SP-R9, SP-R10, SP-R17); and the Land Use Work Group (SP-LU1 and SP-LU2). Review current literature on the natural community types found within the study area and factors affecting their distribution.

(add use of pesticides as data collection needed and link to water quality and land management studies that will collect this info)

Task 2—Analysis of Project-Related Effects on Plant Communities

Evaluate upland plant community status within the study area. This assessment of lands within ~~and near the project area~~ the Study Area will include an analysis of the current vegetation patterns, unique or rare habitats, habitats that support special status species, and the factors affecting their distribution, composition, and condition. It will assess the effect of noxious weed populations and the planting of non-native plant species for wildlife forage on native plant communities. ~~Current~~ It will describe current and future project related effects on these vegetation communities, including recreation, maintenance and operations, land use changes, pesticide use, and fuels management and will identify opportunities to minimize the adverse impacts ~~will be addressed.~~

Task 3—Identify Areas for Revegetation and/or Restoration

Identify opportunities where appropriate to enhance or restore native plant communities within the study area by using information obtained in Tasks 1 and 2 above. This will include an evaluation of conditions necessary for the maintenance of healthy plant communities and opportunities to enhance upland habitats, special status species habitat and rare or unique habitats found within ~~or near the project area-~~ the Study Area.

Task 4 - Draft Report

A draft report will be prepared summarizing initial study results.

Task 5 - Final Report

A final report will be prepared summarizing project-related impacts on upland plant communities (including rare and unique habitats) and potential protection, mitigation, and enhancement measures.

6.0 Results and Products/Deliverables

A Summary Report will be produced which will identify current and future potential projects effects to native plant communities within ~~and near the project area~~ the Study Area. This qualitative assessment will include current vegetation patterns, project-related effects, enhancement opportunities, and proposed guidelines for future development of facilities or land use that will minimize impacts to local native plant communities. This report will provide the basis for development of protection, mitigation and enhancement measures and settlement agreements related to upland plant communities.

7.0 Coordination and Implementation Strategy

Coordination with Other Resource Areas/Studies

Information will be needed from other terrestrial resource studies including SP-T2 (special-status species), SP-T4 (Biodiversity); SP- T3/5 (Riparian and wetland issues); SP-T7 (noxious weeds); fuels management (SP-T11); and SP-G1/G2 (soils and topography). Information on current and future project-related land-use activities will be needed from the Recreation Work Group (SP-R5, SP-R9, SP-R10, and SP-R17), and Land Use Work Group (SP-LU1, ~~and~~ SP-LU2, ~~and~~ SP-LU5) for the evaluation of project-related effects on natural plant communities.

Issues, Concerns, Comments Tracking and/or Regulatory Compliance

This study will address the “effects of existing and future project features, operations and maintenance on upland habitat, including revegetation and restoration efforts ” ~~and the following specific Issues:~~

Direct

- TE40—native plant landscaping (potential sites: Feather River Fish Hatchery, State Parks Headquarters, DWR Field Office, Spillway Launch Facility - future) and restoration of native plant communities

Indirect

- TE62—protection and sustained conservation of terrestrial wildlife and flora in the project-affected area; comprehensive and well-crafted planning; G3 and W7.

8.0 Study Schedule

The schedule is dependent on the completion of work by other terrestrial studies and by the Recreation, Land Use, and Engineering and Operations Work Groups. The analysis in Task 2 and opportunities for enhancement under Task 3 should be completed by September 2003. Task 1, 2, and 3 will be completed in September 2003. An interim report will be completed in January 2003. A draft report produced in Task 4 will be completed in October 2004³. The final report (Task 5) will be completed in September 2004.

SP-T11 Effects of Fuel Load Management and Fire Prevention on Wildlife and Plant Communities

March ~~19~~27, 2002

1.0 Introduction/Background

Relicensing stakeholders have expressed concern that historic land management and fire prevention activities within the FERC project boundary have resulted in increased fuel loading which has lead to an increased risk of destructive wildfire. Relatively little information is available from the project area related to current fuel loads or wildfire risk. The purpose of this study is to provide information to the Land Use Work Group, which is evaluating this issue. Specific information to be collected under this study includes the effects of fire prevention and fuels management practices on native plant and animal communities within the FERC project ~~area~~boundary.

2.0 Study Objectives

Study goal is to provide information to the Land Use Work Group that will allow evaluation of land use practices and options within the project boundary. ~~One project~~The first study objective is to provide information related to effects of historic fire prevention strategies on existing plant communities and wildlife resources within the project boundary. The second study objective is to provide information that will allow assessment of potential fuels management activities impacts (both positive and negative) on native plant communities and wildlife resources.

3.0 Relationship to Relicensing/Need for the Study

The ~~information collected under this study plan is not directly related to hydropower generation. Rather, the~~ information collected in this study will be used to evaluate potential options and risks related to land management practices within the project boundary. The data collected will be used to evaluate potential changes in land management within the project area. The potential changes in land management practices could be developed into PM&E measures. This information is needed by the Land Use Work Group to evaluate and compare the risks, benefits, costs, and liabilities of changing land use practices within the project area.

The California Environmental Quality Act requires evaluation of potential project impacts related to safety including increased risk of wildfire. The fuels management problem is an issue throughout the western United States and an abundance of scientific literature exists related to the ecological effects of both fire prevention and fuels management. Much of this information was collected within California and directly relates to the plant communities and wildlife resources present within the project area. This study does not propose to collect additional information. Rather, the proposed study will collect existing ecological information which that will be used as the basis for evaluation.

4.0 Study Area

The study scope will include terrestrial plant communities and wildlife habitats present within the project boundary. Neither DWR nor FERC have any regulatory authority to alter land use practices on lands outside the project area. However, most of the plant communities and wildlife habitats ~~which~~that occur within the project boundary are also found all along the western slope of the Sierra Nevada mountain range. Therefore, the information collected as part of this study will be applicable to wide areas outside the project boundary and may be used in a cumulative impacts assessment.

Study plans approved by the Environmental Work Group define the limits of the study area. If initial study results indicate that the study area should be expanded or contracted, the Environmental Work Group will discuss the basis for change and revise the study area as appropriate.

5.0 General Approach

The general approach to this study will be a literature review followed by computer modeling, and resulting in a written evaluation comparing the effects of current and potential fuels management. Our hypothesis is that historic fire prevention practices have served to reduce ~~fire-related disturbance~~fire-related disturbance frequency, which has led to changes in plant community composition and structure. These changes can affect the occurrence, density, and distribution of wildlife species.

If initial study results indicate that the methods and tasks need to be modified, the Environmental Work Group will discuss the basis for change and revise the study plan as appropriate.

Detailed Methodology and Analysis Procedures

Task 1--Data Collection

Perform literature review and gather data. The primary sources of information includes the annual proceedings of the Tall Timbers Fire Ecology Conference, discussion with Pacific Southwest Range and Experiment Station fire ecologists, fire ecology literature reviews, and other scientific literature. Coordinate with Land Use Work Group to identify potential fuel load management strategies to evaluate.

Task 2—Habitat Mapping

Obtain mapping of plant communities/wildlife habitats under SP-T4.

Task 3—Ecological Effects of ~~Existing~~ Fire Prevention Practices

Using the information collected in Tasks 1 and 2, develop predictions of and model the potential ecological effects of historic/current fire prevention practices on each of the major plant communities present within the project area. These predictions may include changes in plant succession, density, distribution, size classes, plant species composition, stand structure, understory development, ground cover as well as changes in other physical and biological characteristics.

Task 4—CWHR Analyses of Fire Prevention

Using the California Wildlife/Habitat Relationships Database (CWHR) input the plant community changes identified and modeled in Task 3. CWHR will predict which wildlife species may benefit from the predicted habitat changes as well as those species ~~which~~that could be adversely impacted.

Task 5—Ecological Effects of Fuels Management Options

Using the information collected in Task 1 and 2, develop predictions of ~~and model~~ the potential impact of fuels reduction activities on each major plant community.

These predictions may include changes in plant succession, stand density, species and community distribution, size classes, plant species composition, stand structure, understory development, shrub density and ground cover as well as changes in other physical and biological characteristics.

Task 6—CWHR Analyses of Fuels Management Options

Using the California Wildlife/Habitat Relationships Database input the plant community changes identified and modeled in Task 5. CWHR model output will predict which wildlife species benefit from the predicted habitat changes as well as those species ~~which~~that could be adversely impacted.

Task 7—Summarize and Report

Summarize findings from Tasks 3 through ~~65~~ in a written summary report to be submitted to the Land Use Work Group. This report will include the ecological basis for predicted changes in plant community composition and structure, the individual plant community models, the CWHR model outputs, and a brief statement of findings.

6.0 Results and Products/Deliverables

Results

Study results will be summarized in a written report to the Land Use and Environmental Work Groups. This report will include the ecological basis for predicted changes in plant community composition and structure, the CWHR model outputs, and a brief statement of findings. These data will allow the Land Use Work Group to identify the plant community and wildlife effects of the current fire prevention/control strategy as well as the potential environmental effects of possible alternative fuels management strategies. These plant community effects may include changes in species composition, canopy closure, snag densities, tree understory, stand density, and shrub occurrence.

Products/Deliverables

A report will be provided to the Land Use Work Group.

7.0 Coordination and Implementation Strategy

Coordination with Other Resource Areas/Studies

Study results are one component of ~~Study Plan~~SP- LU5M-2. Study requires information from SP-T4.

Issues, Concerns, Comments Tracking and/or Regulatory Compliance Requirements

~~The following Issues will be addressed:~~

~~This study will evaluate current and potential fuels management options on wildlife, wildlife habitat, riparian, and plant communities.~~

Direct

- ~~Issue Statement~~TE11—effects of fire prevention/fuel load control on natural communities
- ~~Issue Statement~~TE33—fuel load on state lands: potential impact to habitat (wildlife and human Note: human impacts will be addressed in SP-LU5)
- ~~Issue Statement~~TE64—effects of existing and future fire prevention/fuel load control on natural communities

8.0 Schedule

Task 1 completed by September 2002. Task 2 completed by ~~April~~April 2002. Tasks 3 through 6 completed by December 2002. Task 7 completed by ~~October~~October 2003.